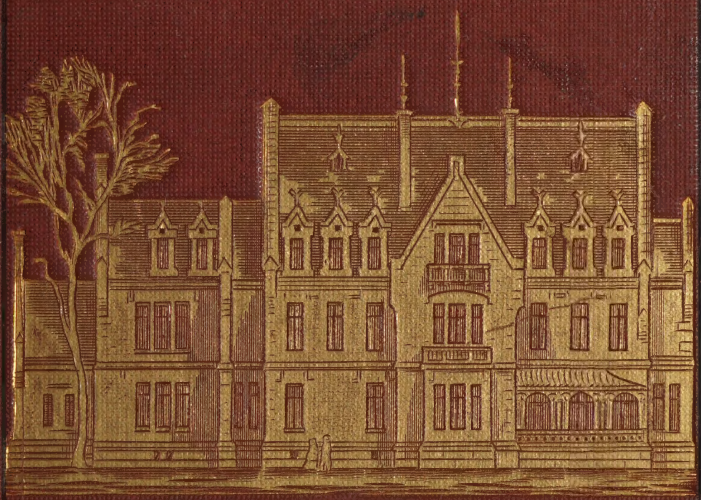
THE STORY OF A HOUSE



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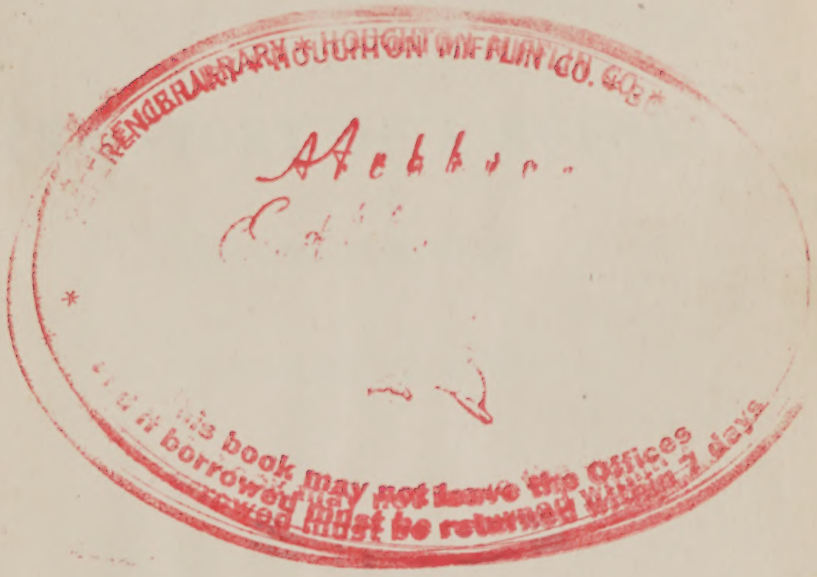
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THE STORY OF A HOUSE

WRITTEN AND ILLUSTRATED BY

VIOLLET-LE-DUC.

THE OLD CHÂTEAU.

THE

STORY OF A HOUSE.

TRANSLATED FROM THE FRENCH OF VIOLLET-LE-DUC

BY

GEORGE M. TOWLE.

ILLUSTRATED BY THE AUTHOR.

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THE STORY OF A HOUSE.

CHAPTER I.

M. PAUL HAS AN IDEA.

A GOOD time is that of vacation. The skies are soft; the country assumes its most alluring garb; the fruits are ripe. All things smile for the young scholar who brings home, in his baggage, the proofs of the useful employment of his time.

Everybody congratulates him on his success, and encourages him to look forward, beyond the six weeks of rest and recreation, to attractive labors crowned by a brilliant career.

Yes, it is a good time; it seems then that the air is lighter, the sun more dazzling, the fields more green. The dull rain seems charged with delicious odors.

No sooner is it daylight, than the scholar hastens to revisit the beloved nooks in the park, and the fountain, and the little lake, and the farm; to make inquiries for the horses, the boat, and the plantations.

He chats with the farmer's dame, who smilingly gives him a nice cake, all hot. He follows the game-keeper, who recounts the news of the neighborhood as he makes his round.

The bells of the flocks charm him, as does the monotonous song of the little herdsman, who has grown somewhat, and aspires to the rank of a full-blown shepherd.

Yes, it is a good time. But, the first days over, the shade of the old oaks, the beloved vicinity, the long walks, the gossip of the game-keeper, and even the boat, become veiled in a secret weariness, if some favorite occupation does not intervene to employ the thoughts. It is the privilege of old age alone to be content with memories, and to find joys always new in the contemplation of the fields and woods.

The provision of memories is soon exhausted by youth, and indolent meditation is not suited to its temper.

M. Paul, at sixteen years of age, did not make these reflections; but after a week passed at the country-house of his father, a gentleman farmer, who possessed a fine estate in Berri, he had nearly exhausted the sum of the impressions to which his return to the paternal acres had given rise. How many projects, throughout the scholastic year, had he not made and postponed to the approaching vacation time! It seemed to him that six weeks would by no means afford him time to realize them. How many things had he to see, to say, to do! Yet in a week everything had been seen, said, and done.

Besides, his elder sister, who had been recently married, had gone on a long journey with her husband; and as for Lucie, his younger sister, she appeared to be more absorbed

in her doll and its trousseau, than in the thoughts of monsieur her brother.

It had rained all day. The farm, which Paul visited for the fiftieth time, seemed to him very melancholy and sombre. The chickens, sheltering themselves along the walls, seemed pensive; and even the ducks, dabbling in a muddy puddle, were taciturn. The game-keeper, having gone out to kill a hare, had carried Paul with him, but both had returned within doors splashed and tolerably moist. Paul had, to his disappointment, found the game-keeper's tales long and tedious; inasmuch as he had heard them, with few variations, for the third time. Add to this that the veterinary surgeon had declared, that morning, that Paul's pony must be kept in the stable a week, on account of a chill.

Paul had read the paper after dinner, but he found the political news little interesting; and as for the news items, they were deplorably meagre.

M. de Gandelau (that was Paul's father's name) was too much engrossed with his land improvements, and perhaps also with his gout, to try to raise the veil of ennui which floated before the vision of monsieur his son; and Madame de Gandelau, still remaining under the feeling of regret at the recent departure of her eldest daughter, worked with a sort of desperation on a piece of embroidery, the destination of which was unknown to any one, and perhaps even to the lady who so carefully plied her needles.

"You have received a letter from Marie?" said M. de Gandelau, putting down the paper.

"Yes, dear, this morning. They are delighted; the weather has befriended them, and they have made, she says, some charming excursions in the Oberland. They must by this time be going over the Simplon into Italy. Marie will write again from the hotel at Baveno —"

"Very well; and their health?"

"Is excellent."

"And their plan is still to go to Constantinople on this important matter?"

"Yes; N——, it seems, has received a pressing letter; their sojourn in Italy will be very brief. They count on sailing from Naples in a month at the latest; and they scarcely expect to return under a year, Marie tells me. She says this, without seeming to be affected by the length of such an absence; and I feel on this account a heart-burning, dear, that the best of all reasoning cannot relieve."

"Good! Think you, dear wife, that we marry our children for ourselves? And was not that agreed upon? They say that few affections are strong enough to resist travelling in company. N—— is a worthy and honest fellow, laborious and somewhat ambitious, — which is by no means a bad thing. Marie loves him; she is intelligent and well bred. They will come out of the ordeal successfully I doubt not, and will return to us like two good comrades, having learned

to know each other well, to aid each other, and suffice for each other, with that grain of independence which it is necessary to have, in order to live in good accord with one's kindred."

"You are perhaps right, my dear; but this long absence is none the less melancholy, and the year will seem to me a long one. In spite of all, I shall be very happy when I can occupy myself arranging their room here, and when I shall only have a few days to reckon before their arrival."

"No doubt, no doubt! and I too shall embrace the dear creatures with all my heart, — and Paul, too! But, since it is settled that we shall not see them for a year, it would be a good time to resume my project."

"Which project? The erection of the house you wish to have built on that piece of land which is a part of Marie's dowry? Don't do that, I beg of you. We have room enough already for them and their children, should they have any. And after this long absence, it would be a new grief if Marie were established apart from us, and not to have her near me. Besides, her husband could not remain three quarters of the year in the country; his avocations do not permit it. Marie would, then, be often left alone. What do you think she would do in a house, with her husband absent?"

"She will do, my good wife, what you have done yourself when business has called me, as has often happened, away from home; yet we, too, were then young. She will

busy herself with her house, she will get the habit of managing her household, she will have occupation and responsibility; therefore, contented with herself, and happy in what she will have created about her. Believe me, I have seen the tenderest family affections die out in this common life of young married people with their parents. The wife aspires to be absolute mistress in her own house, and this is a true and healthy sentiment; it should be met and encouraged. The woman who is wisely brought up, and has charge of a house, with its responsibility, and the independence which is the consequence of all responsibility, knows better how to be happy than one who is retained in perpetual tutelage. Marie would be very well here, very happy to be here, and her husband would be not less happy to know that she was with us; but she would not be in her own house. A young girl is only in her place when she is with her mother: a wife is only in her place in her own house; and thus, even when she is with her mother, it is on the footing of a guest. Admitting — what is difficult — that no coolness arises from this life in common, it is at least certain that there results from it a want of interest in practical things, nonchalance, even weariness and all the dangers which attend it.

"You have brought up your daughter too well for her not to ardently desire to fulfil all her duties; you have also shown her a too constant activity for her not to wish, in her turn, to be active likewise. Give her the means of doing

this. Would you not be happier to see her keeping and directing her household well, receiving us cheerfully, than to always find her here, tied to your apron-strings, with nothing to do; a silent and respectful judge if you will, but after only a judge of *your* ways of doing things? Do you think her husband will have as much pleasure in coming to her here, when his business permits, as he would experience in seeing her at home, happy in showing him what she has been able to do in his absence, occupied in making their home every day more agreeable and cosey? Don't you see, by reflecting a little, that the young women of these times, who, despite of being well born, have made the saddest failures, are most often those the first years of whose married life have been spent thus, without a hearthstone of their own, leading a life which is neither that of the young girl nor of the mistress of a house, — the responsible housekeeper, to call things by their right names?"

A few tears moistened Madame de Gandelau's embroidery.

"You are right again, dear," said she, holding out her hand to her husband. "What you do will be well done."

Paul, as he fumbled over an illustrated paper, did not lose a word of this conversation. The idea of seeing a house built for his elder sister pleased him very much. Already, in his young imagination, this future house, opposite the old paternal mansion, seemed to him like a fairy palace, all prettily adorned and garnished, full of life and gayety.

It must be said that M. de Gandelau's habitation had little to charm the eye. It had been successively enlarged, and two long wings of rather dull aspect were united awkwardly to the main building, formerly a château, whose two dismantled towers, crowned by flat roofs, flanked the angles. Between the two wings and this main building there opened a low court, always humid, protected by an old iron grating, and the remains of a ditch used for providing the kitchen with plants for soups. A third wing, in prolonging the old building to the towers, which was built by M. de Gandelau shortly after his marriage, contained the private apartments of the proprietors: this was the gayest part of the mansion. The drawing-room, dining-room, billiard-room, monsieur's study, were situated in the old main building. As for the two parallel wings, they contained chambers opening upon irregular corridors, which necessitated a certain caution if one wished to get through them without accident.

The next morning Paul, as he was going to make inquiries as to his pony's health, saw Papa Branchu coming into the court with a small hand-cart full of pieces of wood, bags of plaster, and tools.

"What are you going to do with all that, Papa Branchu?"

"I am going to repair the pigeon-house, Monsieur Paul."

"Ah! suppose I help you?"

"No, Monsieur Paul, you will soil your clothes; you might hurt yourself; it is not your business. But you may see us work, if you please."

"It must be fun to build!"

"As for that, it 's not a pastime; but as for its being tiresome, it 's not that either. When a man works for a good master like your papa, when he gets his pay, and has a bottle of wine when it 's warm, there 's no need of grumbling against the world: it 'll do. A man works his day out, and picks up his tools without spite. You see, Monsieur Paul, this plaster that 's in the cart, — I must pay the plasterer; and the brick, — I must pay the kiln; and so with all. If a man is kept waiting for his crowns, money must be got somehow, — and a man 's in difficulties. But excuse my babble; my boy is there waiting for me."

"Could you build a big house, Papa Branchu?"

"Why, I could, all the same, Monsieur Paul; I built the mayor's, and that 's big enough!"

Paul no longer, as the evening before, finds the hours a trifle long; he has an idea. He cannot get the house planned for his sister out of his head; he fancies it, sometimes as a palace, sometimes as a turreted manor-house, sometimes as a cottage nestling amid ivies and clematis, with many carved balconies. Paul has a cousin who is an architect; he has often seen him working on a smooth board: under his hands buildings arose as if by enchantment. This did not seem very difficult to Paul. The cousin has, in the room which he occupies when he comes to the château, all the implements necessary to him. Paul is going to try to put

one of the plans which occur to him on paper. But a first obstacle presents itself. He must know what will be the proper thing for his sister. Shall it be a lordly mansion with towers and battlements, a cottage, or an Italian villa? If a surprise is to be arranged, it should at least be one that will be agreeable to her. After a full hour of reflection, Paul thinks, not without reason, that he must go and find his father.

"There, there, you are in a great hurry," says the father, at Paul's first words. "Eh, the affair has not got so far as that. You want to make the plan of a house for Marie; very well, try it. But before all, it is well to know what your sister needs, how she desires that her house should be arranged. I have no objection to hastening matters a little. We will send her a despatch."

TELEGRAM.

From X——. To Baveno, Italy. MADAME N——, *Hotel de ——.*

Paul wishes to build house here for Marie. Send programme.

DE GANDELAU.

Twenty hours after the following reply was received:—

From Baveno. To X——. M. DE GANDELAU.

Arrived this morning. All well. Paul has excellent idea. On ground-floor, vestibule, drawing-room, dining-room, office, kitchen not underground, billiard-room, study. First floor, two large chambers, two toilet cabinets, baths; small chamber, toilet-closet; laundry, wardrobes; chambers plenty of cupboards; staircase safe from neck-breaking.

MARIE N——.

Without for a moment doubting that his sister has received and answered his message in good earnest, Paul sets resolutely to work, and, installing himself in his cousin's room, he attempts, by recalling all his knowledge of lineal designing, to realize the plan sent by Marie, on paper. The task presents difficulties so serious, that Paul has to be informed twice that breakfast is waiting. The afternoon passes swiftly away, and at dinner-time Paul comes down to the drawing-room with a large sheet of paper well covered with plans and façades.

"Why, this looks very fine," says M. de Gandelau, unrolling the sheet. "But your cousin is coming to-morrow, and we 'll let him criticise your project."

All night Paul was very restless. He dreamed of palaces rising under his direction; but there was always something lacking to his edifices. Here, windows were entirely wanting; there, the staircase was a rickety ladder, which his sister Marie shrank from ascending. Farther along, the ceilings were so low that one could not stand erect, whilst others were so high as to create fear. Papa Branchu laughed, and stirred the walls with his hands, to show that they were not safe. The chimneys smoked horribly, and his younger sister imperiously demanded an apartment for her doll.

Paul looked over his design as soon as he was out of bed, and it seemed much less attractive than on the evening before; he blushed at the notion of showing it to his cousin,

who arrived about breakfast-time; he hesitated, and thought of destroying this plan that had caused him hard labor for a whole day.

"Father, I think my cousin will make fun of me, if I show him my design."

"My boy," responded M. de Gandelau, "when one has done the best that he can, he must not shrink from criticism, for that is the only means of ascertaining what is deficient in the work, and consequently of acquiring the knowledge we lack. If you thought you were going to be an architect in a morning, you would be very foolish; but if, after making an effort to express, by a design or otherwise, an idea which you thought good, you hesitated to submit this expression to one better informed than yourself, in the fear of provoking more criticisms than praises, that would not be modesty, but a sentiment of very ill-placed pride; for it would deprive you of advice which, at your age especially, could not fail to be valuable."

On the arrival of the cousin, M. Gandelau told his son to bring his attempt, so that the amateur architect might display the sheet of paper covered the evening before with the plan so laboriously worked out.

"Eh, my little cousin," said the new-comer, "do you want to be an architect? Take care! all is not rose-colored in our profession, as on your paper."

In a few words the cousin was apprised of what was

going forward. "Well, this is very good; there is the drawing-room, and the hall. I don't quite understand the staircase: but that 's a detail. And the façades? Why, this is a palace! Columns, and balustrades! There 's nothing more to do than to put hands to the work!"

"True, cousin; suppose we call Papa Branchu; he is at work close by?"

"Softly, this is nothing but a sketch. And how about the definite plans, the estimates, the details of execution? We must proceed with order. You must know, Paul, that the more anxious one is to build quickly, the more useful it is to decide upon every small detail beforehand. Call to mind the weariness of your cousin, Count de ——, who has resumed building his château every spring for six years, without having been able to finish it; because he did not, in the first place, set down all that he wished to do, and his architect has not ventured to adopt, once for all, a well-digested plan. He has lent himself to all sorts of caprices, or rather to all the officious pieces of advice which his friends have tendered, — one about the size of the rooms, another about the position of the staircase, and a third about the style and decoration. We have only a year before us, and so we must only begin when we have become sure of not making any false steps, since your sister must approve of what we have done. Let 's see; let us first agree upon the system of construction you desire to adopt. As we are

pressed for time, we have little choice; we cannot think of rearing a mansion of cut stone from top to bottom; that would be too long and too expensive. We must decide upon a construction at once simple and capable of rapid execution. Does that coincide with your idea? You have put columns to your frontage; why do so? If they form a portico, it will make the rooms dark and gloomy; if they are retained, they will serve no purpose here. And what is the use of this balustrade, placed on the upper cornices? Do you think your sister is going to promenade in the gutters? It is very convenient for the cats. And tell me; I see that, on this plan, you must pass from the hall into the drawing-room through the dining-room. But if visitors come while you are at the table, you will have to beg them either to wait at the door, or to see the family taking dinner. Good! The kitchen opens on the billiard-room. Well, we must study this more closely; shall we set about it? The work will get on faster with the two of us, and you will give me some good ideas, for you know your sister's tastes and habits better than I do. You can also fill out the telegraphic brevity of the programme afforded to us. Think it over, and early to-morrow morning we will proceed to the project in good earnest."

CHAPTER II.

PAUL'S IDEA IS DEVELOPED, WITH A LITTLE ASSISTANCE.

EARLY the next morning Paul went to his cousin's room. Everything was ready; board, T, squares, compasses, and pencils.

"Sit there, little cousin; you are going to express the result of our consultation on paper, as you know so well how to use our tools. Let us go on methodically. First, you doubtless know the spot where your father proposes to build the country-house for your sister?"

"Yes; it is below, beyond the wood, about three thousand yards from here; in the little valley at the bottom of which runs the stream which turns Michaud's mill."

"Show me where it is on the plan of the estate. O, here it is!"

"You see, cousin, it is there. On the southern elevation there are cultivated fields: then the land descends, a little, on the north, towards the rivulet. Here is a fine running watercourse, coming out of the wood on the west. On the slope of the plateau, and at the bottom of the valley, are some fields with a few trees."

"On which side is the best view?"

"Towards the bottom of the valley, in the southeast."

"How do we get to that field from here?"

"By crossing the wood; then you descend to the bottom of the valley, by this road; you go over a bridge, which is here, and then ascend obliquely this way by the plateau."

"Good; then we must put the house nearly at the summit of the slope which faces the north, while sheltering it from the northwest wind under the neighboring wood. The entrance should face the ascending road; but we must dispose the principal rooms of the mansion on the most favorable side for exposure, which is that of the southeast; besides, we ought to profit by the open view on the same side, and not neglect the running watercourse, which descends on the right towards the bottom of the valley. We are going then to place the house on the spot which nature has arranged so favorably for us, some yards below the plateau. We shall thus be tolerably sheltered from the southwest wind, and we shall not have in front the plain, which is pretty dreary, and extends beyond the view. This decided on, let us see your sister's programme. She does not indicate the size of any of the rooms; we must consider this for ourselves. From what your father tells me, he intends this house as a permanent residence; that is, to be lived in summer and winter, and to contain, therefore, all that is necessary to a great landed proprietor. He proposes

to devote two hundred thousand francs to its construction; it is a matter, then, to be seriously studied, as your sister and her husband wish to be comfortable. I have visited them in Paris, and I found their house admirably arranged; but there was nothing indicating a love of mere display. We can, then, start out from these data. Let us begin with the plan of the ground-floor. The principal room is the drawing-room, the place where the family assembles together. We can scarcely allow it less than five metres* in width by from seven to eight metres in length. Draw first a parallelogram representing these dimensions. Ah no, not that way, you are too fast! Take a scale."

At this word, Paul looked inquiringly at his preceptor.

"I forgot. You don't know, perhaps, what is meant by a scale? I notice, indeed, that your plan has not taken such a thing into account. Listen to me. When you wish to erect a house, or any other building, you give the architect a programme, that is, a complete list of all the necessary rooms and offices. That is not all: you say, such a room must be such a width by such a length, with such a surface, in order to contain so many persons. If, for instance, you are referring to a dining-room, you say that it must accommodate ten, fifteen, twenty, twenty-five people; if

* The French *metre* is a little over one yard and three inches. With this knowledge, the reader may, if he chooses, calculate the dimensions stated in the text in English measurements. — Trs.

to a bedchamber, that besides the space for the bed, it must hold such and such pieces of furniture, or occupy a space of 30 or 36 metres, etc. Now you know that a surface of 36 metres is given by a square of 6 metres a side, or by a parallelogram of 7 metres by 5.15 nearly, or of 9 metres by 4. But in the latter case the room would not have dimensions convenient for a chamber, but rather those of a gallery. Then, independently of the space necessary for a room, you must have, between its breadth and its length, certain relations indicated by the purpose for which the room is intended. A square drawing-room or chamber is well enough; but a dining-room, which is to afford room for ten or twelve persons at table, must be longer than it is wide, since the table is extended in length according to the number of the guests, but not in width. You must therefore put stretching space in the dining-room, as you do leaves in the table. Do you understand?

"Well, then the architect, in order to draw up his plan, though it be only an outline, adopts a *scale;* that is, he divides a line, on his paper, into a number of equal parts, each representing a metre. To economize time or simplify the work, he takes, for each of these divisions, the two hundredth or the one-hundredth or the fiftieth of a metre. In the first case he says, scale of five millimetres* or of a half-centimetre† per metre, or scale of one two-hundredth;

* A millimetre is the 0.003937 of an inch.

† A centimetre is 100th of a metre.

in the second case he says, scale of one centimetre per metre, or scale of one one-hundredth; and in the third, scale of two centimetres per metre, or scale of one fiftieth. Thus you draw up a plan two hundred, one hundred, or fifty times smaller than what is really to be executed. It is needless to add, that you can make proportional scales to infinity; of one, two, or three millimetres per metre as per 10 metres, per 100 metres, or per 1,000 metres, which is done when they prepare maps. Just so the details are set down on the scale of 50 centimetres per metre, or one half the size of that which is to be constructed; of 20 centimetres per metre, or one fifth of the real space; and so on. The scale adopted, the architect thus gives to each part of the plan dimensions which are relatively exact. If he has taken the scale of one centimetre per metre and wishes to indicate a door of 1.30 metres in width, he takes 0.013 metres.

"Do you quite comprehend me? I am not sure of it; but practice will make you familiar with it in a few hours. In order to show you how useful the scale is, I will take your plan. Your drawing-room is a parallelogram. Let us suppose that it is six metres by eight, which is nearly the relative proportion of the two sides. An eighth of the long side, taken by the compass, is a metre. I carry this measurement to your frontage, and find that your ground-floor is nine metres high. Just imagine what, not only your drawing-room, but

your hall would be; the hall is scarcely four metres long, and yet it is nine metres between floor and ceiling! That would be a well. The height is not, you see, in accord with the scale of your plan. Take, for your sister's drawing-room, twenty-eight millimetres on this graduated rule, which will give five metres sixty centimetres, on the scale of five millimetres per metre. Very well; that is the shorter side of the drawing-room. Now take forty-one millimetres on the same rule, which will give eight metres twenty centimetres; that will be the long side. Your parallelogram is now traced in perfectly exact relative dimensions. You are going to surround this room with walls; walls are necessary to receive the joists; and a wall through which chimneys must pass should not be less than half a metre, or fifty centimetres, thick. Your drawing-room will thus stand upright by itself. After the drawing-room comes, in importance, the dining-room. Where shall we locate it? In the country-house, you must enter it directly from the drawing-room. Shall it be on the right or on the left? Neither you nor I can tell; but chance must not decide the question. Let 's reason a little. It is very easy to put the kitchen next to the dining-room; but the kitchen is an inconvenient apartment to have there. When you are at the table, you don't want to smell the fumes of cooking, nor hear the noises made by the cooks. The kitchen ought to be near the dining-room, and yet so far off that one would not be re-

minded of its existence. Moreover, the back-yard, the out-houses, the poultry-house, a small kitchen-garden, wash-houses, and so on, ought to be near the kitchen. It is necessary, too, that the kitchen should not have a southern aspect. We must not forget that your sister, who proposes to keep the house, had the precaution to say, in her brief programme, 'kitchen not underground!' She was right. Underground kitchens are unhealthy for their occupants, are difficult to look after, and spread their odors through the ground-floor. We will place it, then, on the same floor with the dining-room, but not having direct communication with it, so as to avoid the smell and the noise. Let us examine the aspect and views of our ground. The least favorable aspect for the house, and that which, in this case, offers the least agreeable view, is that of the northwest. We will put the drawing-room, then, with its exterior angle towards the southeast, and on the right we will have the dining-room; and beyond this the kitchen, which will thus be towards the north. Don't be in a hurry to mark out these latter apartments, for we must know what relations they should have with the drawing-room and the hall. A billiard-room is asked for. It must be, with the dining-room, situated towards the southeast. Then we must have the hall, and a study for your brother-in-law near the front entrance. If we place the dining and billiard rooms, which should be about the same size as the drawing-room, side by

side with this as to its length, the drawing-room will only be lighted from one of its smaller sides, for we must put the hall in front. In that case the drawing-room would be very gloomy, and afford a view of the country only on one side. Then let us mark out the dining and billiard rooms perpendicularly to the drawing-room, while having the latter project in the direction of the best aspect. Let us give to each of these rooms seven metres of length and five metres fifty centimetres of breadth. These are convenient dimensions. Then trace the hall in front of the drawing-room. We will determine the size of the hall presently.

"Now let us try to place the walls of these rooms in the position demanded by the construction. We must pass from the drawing-room into the dining and billiard rooms. The opening from the drawing-room into the billiard-room must be large enough for persons in both to be, as it were, together, and to converse with ease. But it is necessary, too, that you should be able to go from the billiard-room and also from the dining-room into the hall, without passing through the drawing-room. We have already said that there must be side-views from the drawing-room, which is to have a length of 8 m. 20 c. If we take 2 m. 40 c. for the side-views, and then 0.50 c. for the thickness of the wall of the billiard or dining room, there will remain 5 m. 30 c. to the entrance partition of the drawing-room; our billiard-room as well as the dining-room being 5 m. 50 c. in

width, these rooms will extend 0 m. 20 c. beyond this entrance partition. Never mind that. Let us mark out the second wall, always having a thickness of half a metre. There are the three principal rooms set down. In the axis of the billiard-room we will make an opening into the drawing-room, of 2 m. 60 c. On the side of the wall separating this from the dining-room we will open a door upon the dining-room of 1 m. 30 c., 0 m. 20 c. from the partition separating the drawing-room from the hall. Thus we shall enter the dining-room, not in the axis, but laterally, which is more convenient; for you know that when people go into and come out from dinner, the gentlemen offer their arms to the ladies. It is necessary that in going in and out there should not be any obstacle to obstruct the progress of the couples. The door leading from the drawing-room into the dining-room, moreover, should not be in the axis of that leading from the drawing-room into the billiard-room. This door should be the counterpart of the window opening on the same side, and between them we will place the chimney. We will open a central door from the hall into the drawing-room.

"In front, along the billiard-room wall, we will place your brother-in-law's study, with a small antechamber adjoining, where people who have business with him may wait, without having to wander about in the hall. At one side of the dining-room we will put the butler's pantry. The study

must be at least 3.90 metres wide. We will have the hall project a little so as to form a good front.

"A serious question in regard to every house is that regarding the staircase. This ought to be in proportion with the building; neither too wide nor too narrow. It must not be put in a useless or inconvenient place; it must give easy access to the upper stories; and it must be conspicuous. If we put a part of the staircase in the hall, which is very large, — 4 m. 90 c. by 5 m. 50 c., — would this be conspicuous, and would we gain any room? The steps of a staircase in a house like this must be at least 1 m. 30 c. in width. But it is also indispensable that we should be able to go directly from the hall into the dining-room, the pantry, and all the services placed on the right of the plan. Let us reserve a passage of 1 m. 30 c., and place a first step. The height of the ground-floor, according to the dimensions of the rooms, should be 4 m. 50 c.; this will give a vacant space of 4 m. 20 c., reserving 0 m. 30 c. for the thickness of the first-story floor. The steps of an easy staircase should be nearly 15 centimetres in height; to ascend 4 m. 50 c., therefore, we must have thirty steps. Each step should have a width of from 25 to 30 centimetres. The staircase must thus furnish us an expansion of 7 m. 50 c. for steps of 25 c. width, or of 9 metres for steps of 30 c., since we count upon thirty steps. Let us take a mean figure, — 8 m. 25 c. We must find this expansion of 8 m. 25 c. at least.

We will, then, establish a pavilion at the angle of the hall, sufficiently projecting that, in passing around a newel,* which will be in the prolongation of the wall at the right of the drawing-room, we shall reach the first story by the antechamber on that story. I mark out this staircase for you, and we will return to it anon. The first fifteen steps come in the line of the newel and the wall, and enable us to place water-closets below the farther part of the tread, for the family, on the ground-floor.

"On the passage beyond let us locate the pantry, then the circular servants' staircase, then the servants' pantry, then the kitchen in a wing, a bake-house, and a wash-house, the latter permitting an exit from the kitchen to the kitchen-garden. Turning round, we will place a stable for three horses, a carriage-house for two carriages, a saddle-room, and a small staircase to ascend to the rooms of the coachman and groom, and to the fodder-room under the roof. At the side of the stable we will reserve a direct descent to the court and larder, and will put water-closets for the servants. We will separate the stable and its arrangements from the rest of the house by a wall with a trellis, at the right of the circular servants' staircase; this will give us a court for the kitchen, the stable, and the carriage-house. In

* A newel is "the upright post about which are formed winding stairs, or a cylinder formed by the end of the steps of the winding stairs." —*Webster's Dictionary.*

front we will reserve a space for the poultry-yard, rubbish-hole, etc.

"Now that the plan of our ground-floor is marked out, let us try to improve it in detail.

"It would be a good thing to have, at the end of the drawing-room looking upon the garden, an alcove or bay-window. Nothing prevents our placing one at the end of the billiard-room, with a divan where the gentlemen can smoke, and a third at the end of the dining-room, which would enable the dishes to be passed through from the servants' pantry, and a side-board or table to be placed there for carving. And we will utilize these additions on the first floor.

"But you must pass directly from the drawing-room or billiard-room into the garden. I confess that I am not partial to those outer flights of steps which are so hot in the sun, and so disagreeable when it blows or rains; if, then, on the side of the billiard-room, we establish a green-house with an interior staircase, in the angle which the drawing-room forms with the billiard-room, it seems to me that it would be an excellent arrangement. Thus you might pass from the drawing or billiard room into the green-house, where you might take your coffee when the weather was bad, and reach the garden by a covered way. A few flowers and shrubs, disposed along the glass side, would add a gay appearance to the billiard-room, without shutting out the light. But we would put a real flight of steps in front of the hall, which we should take

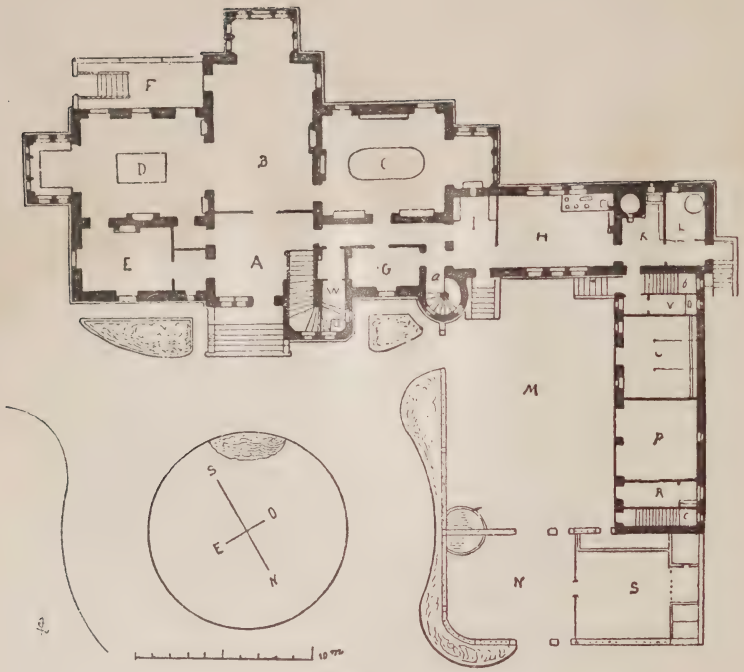


FIG. 1.

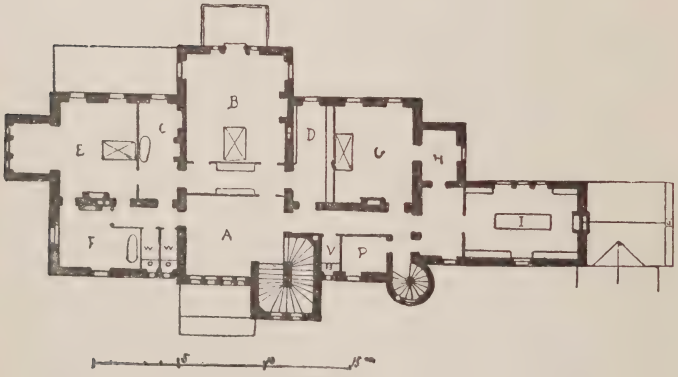


FIG. 2.

Fig. 1. — PLAN OF THE GROUND-FLOOR. — Page 27.
Fig. 2. — PLAN OF THE FIRST STORY. — Page 28.

care to shelter; and this the position of the staircase would enable us to do.

"Now draw this plan, as correctly as you can; we will examine it again when we have studied the first story, the arrangement of which may force us to alter some of that of the ground-floor. (Fig. 1.)*

"So far so good. Let us first mark where the staircase ends. The last of the thirty steps which we need is in a line with the wall on the right of the hall; the top stair brings us to the antechamber situated over the hall. Over the drawing-room we will put the chamber of the mistress of the house; but as this chamber would be too large, we will profit by the superfluous space to put up a second partition, which will have doors on both sides and give room for closets, of which ladies never have too many. To afford light for this space we will make the upper portion of the partition, which shuts out the antechamber, of glass. There being two doors, madame will be more retired in her chamber, and shut out from the noise of those going and coming. Besides, this second private antechamber will enable us to establish a direct communication with monsieur's apartment, which we will put

* *A*, hall; *B*, drawing-room; *C*, dining-room; *D*, billiard-room; *E*, monsieur's study; *F*, green-house; *G*, pantry; *H*, kitchen; *I*, servants' pantry; *K*, *L*, bake-house, wash-house; *M*, servants' court; *N*, *S*, poultry-yard; *O*, stable; *P*, carriage-house; *R*, saddle-room; *a*, servants' staircase; *b*, descent to cellar; *c*, groom's staircase; *V*, *W*, water-closets.

on the side having the best aspect; that is, over the billiard-room.

"As this space is also too ample, we will use the surplus for a toilet-boudoir and bath for madame; and we will enter monsieur's chamber directly from the antechamber, by a private passage, which will also open upon madame's boudoir, upon monsieur's toilet-room, placed over his study, upon the bedchamber, and upon the two water-closets provided for these two rooms. Thus, by closing the two doors leading to the antechamber, the master and mistress of the house will be completely secluded. Repeating the corridor of the ground-floor on the right, we shall establish a communication between the antechamber and the servants' staircase, the laundry (an important matter), which we will locate above the kitchen, a large wardrobe for madame on the right of her chamber, and a nursery (for we must foresee everything), which, as well as the wardrobe, will be put over the dining-room. The ground-floor alcove, carried up, will make an excellent toilet-cabinet for the children's or spare chamber on the first floor, and that of the billiard-room will make a very agreeable addition to monsieur's room. As for that of the drawing-room, we will cover it with a terrace, which will give madame's chamber a fine balcony, where an awning and flowers can be placed in summer. (Fig. 2.)*

* *A*, antechamber; *B*, madame's room; *C*, toilet-boudoir and bath; *D*, wardrobe; *E*, monsieur's room; *F*, toilet-room and bath; *G*, room; *H*, toilet-room; *I*, laundry; *P*, rubbish-room; *W*, water-closets.

"You see, little cousin, that our plan begins to assume order. It will soon be breakfast-time; let us take a short stroll, and this afternoon we will resume our work; that is, proceed to consider the elevations."

As Paul descended to the garden he examined the paternal mansion with a new interest. It had never before occurred to him to observe the construction of the house. He computed the space wasted by the endless passages; he saw, here and there, dark places which led nowhere. The staircase opened badly; one must know the house well to find it on the ground-floor. The kitchen was far away from the dining-room, and it was necessary to cross a carriage-way, go down two steps, and up six, to reach one from the other. This, for the first time in his life, seemed barbarous. As he strolled along, waiting for the tinkle of the breakfast-bell, he asked himself if his father would not do well to demolish his old manor-house, and build a new one on a fresh plan, matured by himself aided by the advice of his cousin. He calculated one by one all the faults in the arrangement of the paternal mansion, its too numerous snares for breaking necks.

He saw the gloomy drawing-room, flanked on two sides by two old towers, which intercepted the side-views; his father's little study, lighted by a narrow window, and preceded by a large apartment which was unused, and served as a fruit-room in the autumn; and many other faults.

"Well, my lad," said his father, when they had sat down

at table, "it seems you have already been at work this morning."

Paul, all absorbed in his subject, gave a tolerably accurate description of the plan they had developed, but could not resist some critical remarks on the subject of the paternal mansion.

CHAPTER III.

THE TREE OF SCIENCE.

HIS mother looked at him with astonishment. As for his father, he became grave, and spoke as follows: —

"Paul, this house pleases your mother, and such as it is, it pleases me also. You and your sisters were born in it. I inherited it from my father, and I have made only such additions to it as were necessary. There is not a corner of this house which does not recall to me some memory of happiness or sadness; it is consecrated by the work of three honorable generations. All the people of the country round-about, who call it the "château," know that they find here bread when they are in want of it, clothing for their children, advice in their differences, and aid when they are ill. They have no need to be told where the staircase is, which leads to your mother's room, or to my study; for they know it as well as we do, and they know as well as we where to find those neck-breaking places to which you refer, and do not lose themselves in the long passages. If the kitchen is at some distance from the dining-room, it is large enough

to hold the harvesters when they repair hither for their supper, and the shepherds when they come to settle their accounts. I don't think I have the right to change all this, for this house is everybody's house here; and you ought not to forget, any more than I, that in 1793 my grandfather remained here alone with his wife and my father, without fear of injury, whilst all the neighboring châteaux were abandoned and pillaged.

"When we shall have departed this world, your mother and I, you will do what you will with this old house; but if I have any advice to give you, keep it as it is, for it is good to stand longer than your time and that of your children. Keep it, for you would have to commit many faults to make it no longer a protection for our family.

"I know as well, and probably better than you, all that is wanting to make it a residence in unison with the taste of the times; and should I sell it to some rich proprietor, no doubt he would hasten to demolish it and erect a more comfortable house, or château, which would be more proper to modern customs. But what he might do I could not, and ought not.

"These worthy folks who come here to talk with me, having wooden shoes on their feet and rough cloaks to their backs, and who would, if need be, protect my old house (they have proved it to me), would not come to a new house, which they failed to recognize, and where everything would frighten

and confuse them. I should gradually cease to see them; and, while it seems to me quite natural to see them, at any time of day, in this ancient habitation, which is simple and a trifle awkward, like themselves, it would probably appear strange to introduce them into apartments arranged and decorated according to the fashion of the time.

"What has become familiar to the eyes must not be disregarded; the country people unite in their thoughts the proprietor and his house; change the latter, and they would no longer recognize the former.

"Your cousin knows, better than you and I do, what the faults of an old manor-house are, and how it might be made much more attractive; yet he never has suggested to me that changes might be made, for he understands as well as I that in changing something in these buildings, a derangement of settled habits around us would ensue, which could not be otherwise than to be regretted.

"Here you are, an architect of two or three hours' standing; and before knowing whether or not you could improve that which exists, you think of demolishing.

"You must be more modest; when you have studied long and seen much, you will find that the dwelling ought to be, for a man or his family, a garment made to his measure; and that when a dwelling is in perfect accordance with the manners and habits of those who are sheltered beneath its roof, it is excellent. How many proprietors have I seen

who, in destroying the house left them by their fathers, to replace it by a habitation conforming, as they thought, with the exigencies of the moment, at the same time broke the bond which attached their family to the humble dwellers of the neighborhood!"

Paul had no other response to these arguments than to embrace his father and mother; and it was the best thing he had to do.

"I don't quite understand," said he to his cousin, when they had gone out into the park after breakfast, "why my father wishes to build a house for my sister, since he finds it so necessary to preserve the old house where we were born, for her and for us."

"It is a delicate subject, but you are of an age, little cousin, to comprehend it. First of all, your sister Marie bears now another name than yours; well, a known and respected name is, for the neigborhood, like the old mansion to which it is, so to speak, attached. If you were not born, and your father and mother were no longer living, your sister, on returning to live on this estate with her husband, might with impunity tear down the old house and erect a new one; for it would not be more difficult to persuade the neighborhood to accept this new house than the name of the new proprietor. She would create new bonds with this little world which surrounds you, and consequently establish other relations, probably, between this

little world and her new family, than those which now exist between your father and his humble neighbors. The relations between your father and the peasants in the midst of whom he has always lived are the result of traditions transmitted without interruption through several generations. He could therefore obtain from them services; and inspire them with a confidence, which would not be accorded to new-comers with a name other than his. So, also, these countryfolk accept benefits without distrust, which they know, from a long experience, to be disinterested. Were the old manor to be occupied by a stranger, with a new name, it would lose the prestige so justly valued by your father; then there would be no advantage in preserving its special aspect and arrangement.

"M. de Gandelau, who does nothing hastily, has quite understood that some day or other, and by the force of circumstances, his house might not be convenient for his children, and, before letting it disappear, he erects a new one for your sister, — a mansion which will gradually become familiar to the neighborhood, and form a fresh nucleus; for Madame Marie knows the art of making herself beloved, and is known by every one hereabouts for her lovely qualities. People will become accustomed to the habits of the new household, and nobody will then find it strange if the old house is altered or torn down. Your father is preparing a transition from customs which are passing away, even in

the country, — which, however, still exist, — to the customs which are to replace them. You see, then, that if he clings to the past, and tries to preserve its best relics, he does not believe in its perpetuity, and foresees the time when it will forcibly disappear, in presence of the habits and necessities of the new epoch. As natural as your father's ways seem to be, because they are the results of habits transmitted continuously through several generations, so difficult would it be for a new-comer to conform to those habits. Besides, this domain, which M. de Gandelau has understood so well how to use, and to make more valuable, will be of necessity divided among his three children when he dies. He has already set apart the portion intended as your sister's dowry. Well, he intends that this part shall, from this time, be put in harmony, by means of the house that we are going to build, with the habits of the new proprietors, who are young, and have ways which are necessarily different from those of your father. Later on, you will be able to appreciate all these things. Come, let us get to work."

Paul tried to make the serious ideas of his cousin clear to his mind. He recalled the conversation he had recently heard between his father and mother, and ideas wholly new to him evidently absorbed his thoughts. However that was, the old mansion now assumed to him a venerable aspect, and his thoughts regarding it wandered wide of finding fault with its bad arrangement and its awkward exterior.

CHAPTER IV.

PAUL'S IDEAS ABOUT ART, AND HOW THEY WERE MODIFIED.

"BEFORE resuming your pencil," said the cousin, "you must know what you wish to do. We have marked out a sketch of our plans. We know that they can be put in practice, and that the construction will not present any difficulties; that the walls separating the rooms on the two floors are upright, the one above the other; that the capacities of the floors are reasonable, and that the openings are in convenient places. That 's very well. Now, do you see these plans elevated, as they would be when actually built? That is, do you see the house erect, with its floors, roof, and so on?"

"Well, — no."

"Good! You must, first of all, represent this house to yourself as if it really existed. I know that this is scarcely possible, for many architects are no further advanced than you when they have traced horizontal plans on paper; and, in tracing these plans, do not see their buildings being erected in their fancy. Think a little; examine these figures carefully, and try in your mind to give them

some appearance in elevation, before taking up your pencil. Take plenty of time. I have a letter to write, and some accounts to put in order; while I am doing so, try to give me the elevation of one of the sides of the house, — the front face, for instance, on the northern side, — and we will discuss the result. I only recommend one thing to you, — to put nothing on paper without having first reflected on the convenience and utility of what you propose to design. Come, have courage, and don't forget the scale of proportions!"

Paul was much embarrassed, and found the task a very hard one. His ideas, which had come to him plentifully enough at first, now seemed to desert him. Still, after a laborious hour and a half, he handed his cousin an outline.

"That might be worse," said the cousin. "You have given a height of 4 m. 50 c. to the ground-floor between floor and ceiling, and that is what we decided to do; but why do you give the same height to the first floor? The rooms are smaller, and there is better ventilation; therefore it is not necessary to give the first floor so great a height, and four metres will amply suffice. But why round windows on the ground-floor? Round windows are difficult to supply with sashes, and are awkward to fit with fastenings, shutters, or blinds. Good! Your windows on the main staircase are not out of range, and would be cut off in the middle by the steps, which would obstruct their being

opened, and render the panes liable to be broken by a stroke of the foot. Then your staircase-frame does not rise above the cornice, and would not permit access to the floor under the roof.

"It is the same in regard to the servants' staircase. Your roofs are made with two slopes. That is scarcely worth while in a place like this. We must have roofs with a simple slope, and without hips, which make repairs difficult. Gables would be better. You have marked chain-courses in the angles. I see no harm in it; but how will you construct your perspectives of windows encircled by a set of pilasters? No chimney-tops rise above your roof; but you know these must be in sight. Your attics are too low, and one would knock his head if he tried to look out-doors. The lintels of these dormer-windows must be at least two metres above the floor. And why oval dormer-windows? They are very inconvenient, and hard to shut. You have traced the door-steps in perspective, like the Chinese; but that is a detail. And how would you build your walls? With freestone blocks, with ashlar, with freestone and ashlar, or with stone and brick?

"Let 's study this together. When a ground or horizontal plan is drawn independently of the arrangement, the first thing to consider is how the building shall be protected. The most important point in a construction is the means of covering it, since every construction designed for interior

uses is a shelter. That is undeniable, is it not? Well, what do you see in the main body of your building, the plans of which are now before your eyes? Two parallelograms which cut each other thus (Fig. 3), — a first paral-

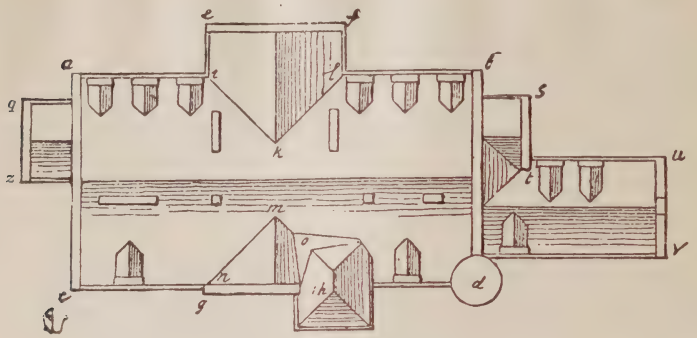


Fig. 3.

lelogram, *a b c d*, cut by a second parallelogram, *e f g h*. We will take no account of the alcoves and staircases. Now, if we mount gables on the walls *a*, *b*, *c*, *d*, the ramparts of which will be equal to the line *a c*, we shall have two equilateral triangles of which the bases will be *a c* and *b d*, and the inclinations at 60 degrees, which is the most convenient inclination for the slating, as the snow would not remain upon it, and this inclination does not give a resistance to the wind. If we erect two gables having a similar inclination on the walls *e*, *f*, *g*, *h*, these walls being shorter than those *a*, *b*, *c*, *d*, the triangles will be smaller, and their summit will not be as high as the first. Then the roof erected on the smaller parallelogram

will penetrate that raised on the larger, and will form by this penetration re-entering angles, which are called gutter-channels; I mark these by *i k*, *k l*, *m n*, *n o*. For, the inclinations of the two roofs being equal, in a horizontal projection, these gutter-channels will divide the right angle into two equal angles; you know enough of geometry to understand that.

"Here, then, is the most simple method of protecting our building; and the most simple is the best. Now, in order that our two staircases should enable us to get under the roof, their frame, or envelope of masonry, must rise above the cornice of the building and furnish an additional floor, especially for them. We will therefore elevate these frames and will establish roofings for them. One, that of the large staircase, shall be pyramidal, with a quadrangular base, and that of the smaller staircase shall be conical.

"Nothing prevents us from erecting alcoves, small gables, on the two walls *q z*, *s t*, always with the same inclination of 60 degrees, and to cover these with two small roofs which will rest upon the large gables *a c*, *b d*. As for the building devoted to the kitchen on the ground-floor, and the laundry on the first floor, we will pursue the same method; and by erecting a gable on the wall *u v*, we shall have a roof over this part, with two inclinations, which will also rest on the large gable *b d*. We shall then have a junction, at the base, of the roof over the lodge *s t*, and of that

over the laundry. We will have a shed, in order to avoid the interior pipes, which shall penetrate these two roofs and will throw off the water at *t*. Then the horizontal projection of this group of roofs will be the tracing which you observe on Fig. 3. The chimney-tops will pass above these roofs, as I have pointed out to you, and these tops should rise at least to the level of the ridging, that is, above the upper edge of the highest roof, so that the chimneys may not smoke. As for the coverings of the outbuildings, which are lower and only have a ground-floor, we will not just now deal with them.

"Let us keep in mind that these gables, rising vertically, will enable us to arrange guest-chambers very conveniently, besides rooms which we must provide for the servants, lighting them by dormer-windows; and we can have excellent windows with balconies, if we choose, for the rooms looking out upon the gables.

"This decided on, it would be well to divide off this floor under the roof. Put a piece of tracing-paper over the plan of the first floor. Good! Now trace all the thick walls, which, necessarily, should rise to the roof, since they carry chimneys. Trace a line, at a metre's distance within the walls which do not carry gables, which indicates the space lost by the inclination of the roof; you will thus have the space which you are able to utilize. The main staircase, as well as the servants', will ascend to this floor. Starting

FIG. 5.

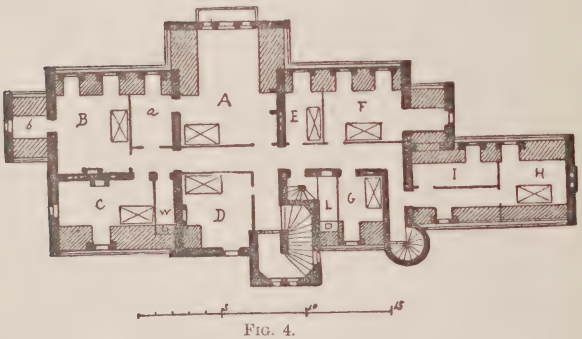


FIG. 4.

Fig. 4. — PLAN OF THE ATTIC FLOOR. — Page 43.
Fig. 5. — FRONT ELEVATION. — Page 44.

from the thick bearing-wall which, extending from the main staircase, joins the angle of the main body towards the southeast, which is the best aspect, we will dispose the guest-chambers, which will thus form a separate 'quarter,' in communication with the rest of the apartments by the main staircase. We can obtain in this part two good rooms, *A* and *B*, with their toilet cabinets, *a* and *b*; then two smaller rooms, *C* and *D*, all having a chimney-place. The water-closet for these rooms will be at *W*. In the other part, and in direct communication with the servants' staircase, we can easily find four servants' rooms, *E*, *F*, *G*, *H*, drains, *I*, and a water-closet, *L*, for the domestics. (Fig. 4.)

"Over the stable, carriage-house, and wash-house, we can find, under the roof, three or four rooms for servants, coachman, groom, and so on.

"Now let us make a sketch of the fronts or façades.

"We will raise the soil of the ground-floor a metre and a half above the soil outside, so that our cellars may be conveniently aired and the ground-floor protected from the dampness of the ground. We will give the ground-floor a height of 4 m. 20 c. under the ceiling. Trace at this level a horizontal band 30 c. in height; this will be the thickness of the flooring. We will give a height of 3 m. 70 c. between ceilings to the rooms of the first floor, which are smaller than those of the ground-floor. Now trace the

thickness of the cornice with its sill, at 55 c. The roofing, the height of which will be determined by that of the gables, will then commence. Taking the entrance front, project the angles of the building, the doors and the windows, vertically, according to the plan. Now you have the outline of this front arranged."

The cousin then took the drawing-board and sketched the front (Fig. 5). A fair copy of all this was made, with a small scale, to be sent to Madame Marie N——, for her criticism, and to be put in execution when her response was received.

Paul began to get an inkling of some of the difficulties which the slightest plan of building entailed, and asked himself how Papa Branchu, who scarcely knew how to read and count, could have built the mayor's house, which was far from a bad-looking one.

When he asked his cousin about this, the latter replied: "Papa Branchu understands the practice of his trade; he is a good rustic mason, who began by carrying a hod on his shoulders, is the son of a mason, and does what he used to see his father do. Besides, he is intelligent, hard-working, and honest. He has learned by practice alone how to build as they build in the country, and perhaps a little better, since he voluntarily reasons about what he is doing. He observes, and is neither conceited nor foolish; he avoids the faults of some, and copies the qualities of others. Should

you see him at work, you would sometimes be surprised at the justice of his observations, the pertinacity with which he defends his opinion, and the average practice of which he knows how to make use. If some one gives him instructions the sense of which he does not thoroughly comprehend, he says not a word, but comes next day to explain what he thinks he has understood, and thus forces you to take up again, one by one, all the doubtful points, and to complete all the incomplete or obscure propositions. I like Papa Branchu, because of the tenacity with which he seeks to comprehend what it is enjoined on him to do, — and this tenacity, which makes him seem a bore to some, is to my mind a precious quality; for he wishes to have foreseen everything, answered every objection, and become familiar with what is needed in all points. He left the service of your neighbor, the chatelain, because they made him undo to-day what he had done yesterday. Ask him about this; it is curious to hear him. This worthy man, who understands nothing but the most elementary practice of his trade, but who possesses this thoroughly, who is familiar with all the materials of the country and the manner of using them for the work in hand, will tell you that the architect of that interminable edifice is an ignoramus, and he will prove it to you, in his way. Still, it is clear that this architect knows a great deal more than Papa Branchu.

"As a general rule, before giving an order, you must have

thought over seven times all the objections to which it can give rise; otherwise, you will now and then find a Papa Branchu, who will show you that you have been a madcap, in a word. An architect has, of course, the resource of shutting the mouths of objectors, when these are placed under his orders; but you do not prove to people that they are wrong by imposing silence upon them; above all, if, some days after, the director of the work gives contradictory orders. Everybody possesses his share of self-esteem, which must be taken into account. As much as a subordinate is flattered, and sees you willing to listen to his observations when they are well founded, so much the more is he disposed to think you incapable if you reject without examining them; especially if you show him shortly after that he may be in the right. There is only one way of establishing discipline in carrying out a work like this; it is, to prove to all that you know more about it than they, and to take account of the difficulties of its execution."

CHAPTER V.

PAUL FOLLOWS A COURSE OF PRACTICAL CONSTRUCTION.

MEANWHILE the letters and papers brought every day melancholy news. A week before the land had been invaded by the enemy. It was hardly seasonable to build. M. de Gandelau was called upon every moment to receive the peasants in his study, who came to tell him their fears and seek his advice. The youths were drafted to be incorporated in the militia. The shops in the neighborhood were closed for want of hands. Groups of peasant men and women wandered along the roads, and, contrary to the peaceful custom of this province, talked excitedly; some of the women were weeping. Field work was suspended; people felt everywhere, as it were, a dismal shuddering; in the cottages lights gleamed till one in the morning; voices were heard of people calling each other. The cattle returned home sooner than usual, and were let out later in the morning. On the roads, when two men met, they tarried a long time to talk. Sometimes, instead of going each on his way, they hurried off together, and directed their steps to the neighboring village.

It was the 20th of August, 1870; on meeting his father in the early morning, Paul found him more anxious than on previous days; and it was not an attack of his gout which made him anxious. The cousin was there.

"The young are too old, the rest are too young," said M. de Gandelau. "If this boy was four or five years older, I would send him with all these other young men who are called on to follow the flag; but happily for his mother he is too young. It will be long, they say. God knows what will become of our poor country, engaged in a senseless war; but we have only one course to take; to remain here in the midst of all these anxious families, deprived of their children; to wait and try to give occupation to these people, who are a little out of their heads. Do not let us abandon ourselves, nor yield to vain anxieties; let us work; that is the remedy for all ills; and misfortune will not find us more deprived of courage after the laborious days than after feverish indolence. I foresee that Paul will not be able to return so soon to his school at Paris. As for you, cousin, nothing obliges you at this time to remain in one place rather than another. Your business will be everywhere suspended. Remain here, where you can make yourself useful as long as the country does not need you.

"Who knows? If the war is a long one, we will try all the same to build Marie's house. It will be a way of giving employment to idle arms. You can teach Paul, by

practice, the elements of construction. We shall fail, perhaps, in that indispensable sinew for building, — money. Well, that will make it necessary to find a way of dispensing with it. We have the first materials, arms, and the wherewithal to nourish them for a while. Let us not, then, give way to discouragement or indulge in useless recriminations; let us work, and we shall only be the better prepared if, in a supreme effort, recourse must be had to all, old men and children, to defend the soil."

As Madame de Gandelau joined her entreaties to those of her husband, it was not difficult to persuade the cousin to establish himself at the château; and three days after, having attended to some matters of business, he returned, supplied with an ample provision of paper and instruments necessary to the execution of the details of building.

They were forced to wait until the plan sent to Paul's sister should be returned, approved or altered, before setting to work; and the cousin decided to employ the interval by giving Paul the first ideas of constructing a dwelling, settling that these lessons should take place in the morning, and that in the afternoon our embryo architect should write out his lesson, to be corrected in the family circle in the evening. Thus the days would be profitably filled out.

First Lesson.

"If you wish, little cousin, we will take our lessons walking, and for a good reason."

This way of proceeding pleased Paul at first, for at school he was not used to this method of being taught. The prospect of taking lessons between four walls, written out between four walls, and corrected between four walls, had not at first seemed to him harmonious with the idea which a boy of sixteen conceives of the sacred hours of vacation, though architecture appeared to be a fine thing from his first attempts; and though he was quite proud to reflect that *his plan* was perhaps at that moment under his sister's and brother-in-law's eyes. Still, in going to his cousin's room, he had looked with a covetous eye upon the big trees in the park and the verdant fields which shone between their black trunks. A sigh of satisfaction escaped from him in descending the steps of the house.

"Let us go slowly towards the spot where we propose to build the house," said the cousin, as soon as they were out doors; "a knowledge of the ground is the first of all that the architect should possess. There are, as you know, several kinds of locations; some are resisting, others are soft and compressible to various degrees. Rocks make the firmest foundations, on which you can build with all safety, provided at least that they have not been excavated or

deranged. We give the name 'virgin soil' to every spot which we find in the state in which the geological phenomena have placed it, and the name of 'made ground' to every spot which has been overturned or deranged by the hand of man, vegetation, or sudden torrent alluvia. As a rule, you must only build on virgin soil; yet among these there are soils you must distrust, as I will show you presently.

"We must, then, try to distinguish a virgin soil from made or altered ground; to do this, a certain knowledge of elementary geology is necessary. Thus crystallized rocks, granites, gneiss, the crystalline slates, remain in the state in which the cooling of the earth and the upheaving of its crust have left them. Sandstone, limestone, chalk, sand, even clay, disposed by the waters under an enormous pressure, are stratified, that is, deposited in beds, like layers of construction, and present, as it were, an excellent site.

"The hill here on our right, towards which your sister's woods extend, presents, as you can see, escarpments made by the stream which we are about to cross; observe that the stone which seems laid bare is disposed in nearly horizontal beds. It is a limestone, excellent for building upon, and upon which you can rest your building in complete security. So, too, you may excavate cellars in those banks, and make use of the excavated material for erecting the walls. We are now walking on sandy clays mixed with

limestone. This also forms an excellent, not compressible, soil. It is otherwise with pure clays; not that they are compressible, but, if they are not packed, — if, for instance, they are upon a declivity of the soil, — by the effect of the water which filters between their beds they slip, and the house erected on their surface descends with them. You also sometimes find villages, situated on clay slopes, slipping down into the valley. We must therefore pay great attention to the method of laying foundations upon clay, if we would avoid such a danger. Sometimes, also, when they are strongly compressed by a heavy building, the clays yield under the weight to swell up a little farther off, by a seesaw motion. The sea-sands, pure, fine, or gravelly, are excellent for receiving foundations, because the sand naturally settles when moistened; so much so that you can, if needful, form an artificial soil by transferring good beds of sand to an unfavorable ground, and by thoroughly moistening them. The finer the sand, and the freer it is from clay, the better it is; for all these small, heavy, equal grains have but slight intervals between them, and are in close contact with each other at several points. If the weight compresses the bed of sand, and forces it to settle, this settling is regular, and hence free from danger. The building thus descends, according to its weight, several millimetres, but is not dislocated, because it sinks regularly. The alluvia formed by sluggish watercourses, that is, by

rivers or lakes, thus compose good soils, because gravel or mud beds are deposited little by little, and are well settled by the weight of the water which disposed them. It is otherwise with marshy soils; for, as the water has no current, it permits plants and weeds to take root in its bed. When these plants die, others each year take their places. Thus successive beds of detritus are formed under a slight pressure, which have innumerable cavities between them, as would a heap of decayed hay. These deposits are called turf-pits. You can erect nothing upon them, for they sink under the least weight. Stop; here we are near the stream, at a point which betrays this very phenomenon. Stamp this thick, turfy soil. You see that the earth sounds hollow and shakes under the shock. Sometimes these turf-pits reach to such a depth, by the accumulation of vegetable matter, that you cannot sound their bottom; if you built over them, your building would sink little by little, often unequally, by reason of the declivity of the subsoil, so that it would lean to one side. It is thus that the towers of Pisa and Bologna in Italy inclined, whilst they were being built, at the moment when the pit was completely compressed under their weight. When you find these soils, either you must clear away the turf until you reach rock or gravel, or else sink piles very near together, like a game of ninepins, until they can be driven no farther. Then on the tops of these piles they raise an artificial foundation,

a sort of frame of carpentry work, between which they run concrete, and upon which they place the first layers of masonry. Entire towns are so built; Venice and Amsterdam rest upon forests of piles sunk into a spongy mud, formed under a shallow sheet of water which is not heavy enough to compress it.

"But it does not suffice to understand the nature of the soil upon which you propose to build; you must also examine the subjacent watercourses, or how the flow of rain-water acts upon their surface or in their interstices. The presence of a clay-bank, slight as it may be, between lime, sandstone, or sand beds, ought to be taken into account; for these banks, being water-tight, that is, not permitting rain-water to penetrate their thickness, favor currents or sheets of water, which might occasion grave derangements in the foundations. Observe this verdant bed along the escarpment; it is clay, but very slight, and could not obstruct the water; but supposing it was fifty centimetres in thickness. The rain, which will easily penetrate the gravel above, will be arrested on this bed, and will take its way according to the inclination of the clay-bed; little by little it will form cavities, like little grottos, and a concealed current. If you make a cellar or foundation wall descending below this sheet of water, the latter will wash against it, will penetrate it, whatever you may do, and will fill your cellars. That is why it will be necessary, in this case, to turn aside this sheet of water, in

drawing it off from your building by means of a drain. Lend me your memorandum-book, and I will show you clearly by a tracing what I am telling you (Fig. 6).

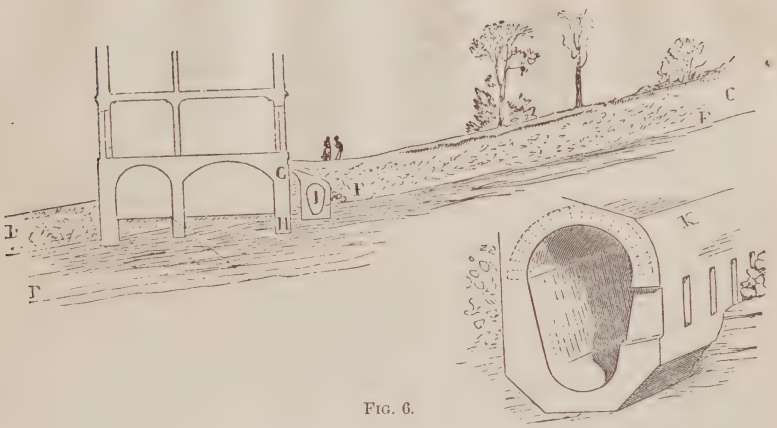


FIG. 6.

"Let *A B* be the clay-bed, *C D* the gravel or sand bed which water can penetrate. There will be formed a sheet of running water, after every shower, from *E* to *F*. This sheet will be arrested by the foundation or cellar wall *G H*, and will soon penetrate it, since it can neither remount nor traverse the clay. You must, then, establish a transversal drain at *I*, with openings upward, by which the water will enter the gutter, as the tracing *K* shows. This drain will carry the water it receives wherever you wish, and will leave the wall *G H* perfectly dry. You comprehend, do you not?

"But if you lay your foundations in the open clay you must take precautions with another object; for, as I told

you just now, it might be that the whole clay-bank would slip.

"Clay-banks slip, above all, when, in their slope, they present such a section as I trace thus (Fig. 7); let *A* be a rock-bank, *B* a clay-bank. The rain-water accumulating above, from *D* to *C*, will pass at *C* under this clay-bank; and if the rain continues long they will form, from *C* to *E*, a soft, thick, soapy bed, so that the clay-bank *C B E* will slip on this bed by its own weight; above all, if that weight is increased by a building at *G*.

Fig. 7.

"How avert this danger? First, in collecting the water at *C* in a sewer or a drain, so that it shall not pass under the clay-bank if it is very thick; secondly, if it has only the thickness of a few metres, in sinking the foundation-wall *H* to the rock or gravel, and in making a collecting sewer at *I*, as I said just now.

"Then the triangle of the clay, *C I K*, cannot slip, being

checked by the well-laid wall. The clay portion below, not being moistened underneath, will not slip. But the wall *H* and the sewer *I* must be thick enough to resist the pressure of the triangle *C I K*.

"You see how important it is to take account of the ground upon which you are to operate; and how essential it is that the architect should know something of geology. Remember this well; for the architects of the last generation despised that study, and left it in many instances to their builders.

"We will also refer to slimy, flat soils, soaked with water, where you cannot dig because they have scarcely the consistence of compact mud, in which the more you penetrate the less resistance you encounter. When such lands are not turfy, contain but little vegetable detritus, and are always penetrated by the same quantity of water, you can build upon them, since water is not compressible. Your building is then like a boat; the whole question consists in preventing the water from escaping from under the weight of the building as it does from under a boat. When you plunge into a half full bath-tub, the water ascends at the sides in a quantity equal to the volume of your body. But suppose that a plank, cut to exactly the contour of your body, prevents the water from rising about you; you could not descend into the water, which would carry you on its surface. Well, when you wish to build on a muddy soil, the problem con-

sists in preventing the mud from rising around the house as fast as it sinks in. I must make a drawing to show you the proper way to arrive at a good result in such a case (Fig. 8).

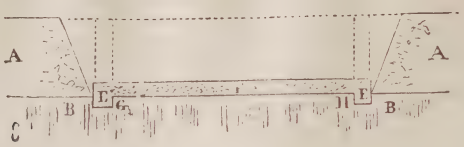


Fig. 8.

"We have dug into a made soil, *A*, that is, a soil on which it is not safe to build. At *B* we reach the virgin soil; but this is very moist, — an old mire soaked with water and into which you would sink in walking upon it. The deeper we dig into this the more moist we find it. A sounding-line sunk two or three metres will always reach the same bottom, and the holes it makes will be at once filled with water. Piles driven in sink to their heads. Now you see very well that, to erect an ordinary building, you cannot spend double the sum on the foundation that you would on the building itself. We must reflect. We will make, in order to receive the walls which form the perimeter of the house, trenches from 50 to 60 centimetres in depth, such as I trace at *E*; then, in the trenches and on the whole surface of the construction we will run concrete of a thickness of from 60 to 80 centimetres between the trenches, as I trace at *F*. We shall thus have made a sort of cover, of a homogeneous material, which

will prevent the mud *G H*, compressed under its borders, from ascending. The weight of the soil *A* will suffice to compress the rest. Thus you could safely build on this plateau.

"You asked what concrete is, and how it is made. This you will learn after a while." While talking and making sketches, Paul and his cousin had reached the ascent of the slope where the mansion was to be built.

"The situation is a good one," said the cousin. "We have an excellent limestone soil, whence also we can take the stone for building. Here, on the lower declivity, are distinct sandy clays, with which we can make brick. Here is the course of the running water which comes from the wood and emerges below the last of the limestone banks; we may easily divert it along the house, where it will be doubly useful, for it will give us water for household purposes, and will carry off in a sewer the slops and dirt, which will be lost in that old excavation which I see on our left.

"It seems to me that these banks have already been worked at several points. We may find, in these excavations, quarries made carelessly, as is too often the case in the country."

"How can you tell the stone that is fit to build with?" asked Paul.

"It is not always easy, and it is with this kind of knowledge, as with many others, that experience ought to con-

firm theory. Among limestones, which usually comprise, with certain sandstones, the material which can be easily quarried and cut, some are hard, others soft; but the hardest are not always those which best resist the corrosions of time. Many limestones contain clay, and as this retains water, when the frosts come the clay parts swell and burst the blocks, the composition of which is carbonate of lime and silex in a greater or less quantity. Limestones free from clay resist dampness and frost. When, as here, you see banks despoiled by an erosion, it is easy to distinguish those which are good from those which are not. Thus, look at this big black block, the solid and naked face of which has been covered with lichens; it is of an excellent quality, for lichens come very slowly; and, as they have been able to attach themselves to this stone, and give it this gray, speckled appearance, the limestone must have long resisted the decomposing action of the atmosphere. Above, you see a bank of almost pure white, and apparently very sound. Well, it has this good appearance only because, at each frost, it lets fall its skin, and its surface is decomposed. If you touch it, you will find that a white dust will remain in your hand. That is so, is it not? Thus the quality of this block is bad, and you see that underneath it the grass is strewn with small limestone exfoliations, whilst the grass under the gray block is free from all dust. It is, therefore, very useful to an architect, when he wishes to build, to go and observe quarries,

and how the banks composing them bear the free air; and, between us, it is what architects nowadays scarcely take the trouble to do."

Second Lesson.

Paul was much pleased with his cousin's method of giving him an elementary idea of construction. The evening before he had written down all that had been explained to him concerning the soil; he had even skilfully added drawings to his text; and corrections had been rapidly made after dinner. But on this day the rain prevented them from going out, and the cousin decided that the second lesson should be given indoors.

"We shall have examples enough before our eyes; the château will furnish us with them. We will examine it from cellar to garret, and will study its materials as well as its method of construction, criticising them if they are bad, and taking note of their good points."

When master and scholar had descended underground, the former began thus: "Observe that this cellar wall, which is next the court, is humid, and that the mortar which unites its stones has nearly everywhere fallen off, especially towards the top. That comes from two causes: first, precaution was not taken, in elevating the wall, to coat it on the outside so that the water would slip down from the soil to its base; and, secondly, mortars have not been used in the building, con-

taining hydraulic lime. There are two principal kinds of lime: one is obtained by the baking of the compact limestone which is usually found at the top of a bank, and which is called 'fat,' because it is glutinous when it is slackened, and attaches itself to the plaster-beater with which it is puddled. This lime, being sunk in water, emits a thick vapor, as you may have seen, and when mixed with sand, thickens slowly. Used above the soil, mortars made with this lime finally become very hard, but preserve more or less, for a time, a certain plastic quality. These mortars, however, thickening slowly, are easily diluted by water, and in that case never become hard. Hydraulic limes, obtained by the baking of clay-lime mixed with sand, rapidly assume, on the other hand, a great hardness, and remain all the more so when the mortar is in a wet place. They call this lime 'hydraulic,' because it is employed in all masonry established in water. They make artificial hydraulic lime, when the soil does not furnish clay-lime, by grinding up a certain quantity of clay with limestone proper for making ordinary limes. The hydraulic lime is recognized by mixing it with water: then it fizzes, but produces very little vapor.

"It is with hydraulic lime that the concretes, of which I told you yesterday, are made. Having prepared the mortar, they mix with it a certain quantity of hard pebbles, of about the thickness of an egg; they puddle the whole, and throw the mixture into the excavations, where they ram it in with

wooden beaters. If the lime is good and the concrete well made, a real rock is thus composed, which resembles natural conglomerates, or pudding-stone. The water with difficulty penetrates these concretes when they have taken consistency, and thus you avoid the subjacent infiltrations which occur in cellars made in very wet soils.

"If the wall you see here had been built with mortar made with hydraulic lime, it would be intact, and its junctions would be as hard as the stone itself. You will easily understand that, when the water has little by little diluted and liquefied the mortar of the layers and that joined to the base of a wall, the stones of which it is composed settle, and so all the rest of the building suffers. This is why the front of this house, looking upon the court, betrays a number of fissures, which are repaired from time to time, but without, of course, getting rid of the cause of the evil.

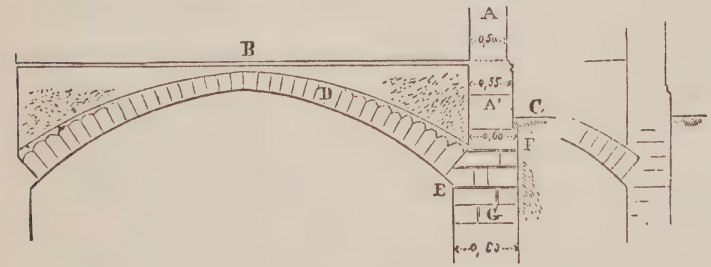


FIG. 9.

"You see that the cellar wall which receives the vault is very thick, much thicker than the ground-floor wall. The latter is only sixty centimetres in thickness, whilst this wall

is nearly a metre. This additional thickness is given to the interior mainly to receive what we call the 'summer' of the vault. A sketch will illustrate for you the reason of this arrangement (Fig. 9). Let *A* be the thickness of the ground-floor wall of a house, which we put at fifty centimetres; if there are to be cellars under this ground-floor, the interior soil being at *B* and the exterior soil at *C*, it will be proper, in the first place, to indicate the interior soil by a projection, a greater thickness being given to this wall on the outer side; let this be five centimetres. At A′ the wall will, therefore, be fifty-five centimetres. Your vault being traced at *D*, you must reserve at *E* a resting-place of at least twenty centimetres, to receive the first keystones of the vault 'summers.' Then it is well to give on the side of the earth a greater projection, in order to firmly set the sub-basement; this projection being of five centimetres, we shall have at *F* sixty centimetres in thickness, and at *G* eighty centimetres at least; for the wall which is to be erected must not bear upon the oblique layers of the vault, otherwise it would not have a good seat, and would be, as we say, 'starved,' or reduced in thickness by the arch which would penetrate it as in the tracing *I*.

"But come into this other cellar, which belongs to the oldest part of the château, and is built with excellent stone. The builder did not wish to lose any space on the interior, and, building with hewn stone, was anxious not to waste the

material. What did he do? (Fig. 10.) He only gave his cellar wall the same thickness as that of the ground-floor. He placed, at intervals, large corbels at sixty centimetres above the soil; on these he keyed in arches with a projection of

Fig. 10.

twenty-five centimetres, and on these arches, which replace the surplus of thickness, or lining-wall, of which I spoke just now, he keyed in his vault. This drawing in perspective will enable us to seize this system of building. Thus the upper wall leaves the vault independent, and rises upright on its lower facing.

"You understand, do you not? Well, let us examine this little staircase, which, perhaps, you have not observed attentively. It is four old-fashioned feet in width, or one metre thirty centimetres; a sufficient width to carry down butts of wine. See here (Fig. 11); the creeping-vault is composed of

as many superincumbent arches as there are steps; it looks well, is solid, and easy to build. In short, where stone steps are established, on these are placed successively a wooden centring, which, of course, juts out at each step, and on this centring an arch is placed, being built rapidly, as the stones

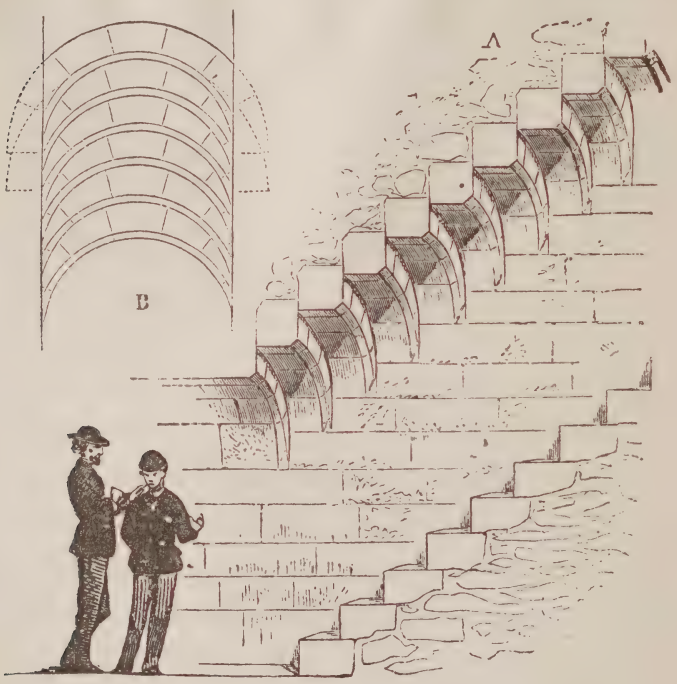


Fig. 11.

are already cut. Thus the arches follow the profile of the steps; and the centring being carried, after the closing of each arch, upon the following step, commencing with the lowest, two men can key in five or six of these arches in a

day. If there are twelve steps, this creeping-vault may therefore be closed in two days. You see, this construction must be indicated in perspective, and geometrically, in your to-day's *resumé*, *A* and *B*.

"Let us ascend to the ground-floor; observe how, on the interior, the walls betray efflorescences which resemble carded cotton. That is saltpetre, which is formed on the interior of the stone, and which, by the dampness of the soil, crystallizes on the facing. Saltpetre alters the stone, ends by gnawing it, and eats off all the paint which is put on the interior wall. Waterproof coatings are made to arrest the effect of saltpetre, but these only retard its appearance, and do not destroy the evil, and the coatings soon fall like a crust. It is necessary, then, especially when a construction is made in the country, to prevent the dampness of the soil from ascending into the thickness of the walls, and to arrest it at the level of the soil. Attempts have sometimes been made to interpose a bed of bitumen between the stones of the sub-basement, at the place of the layer of mortar, to prevent the stones from sucking in the moisture, which is called 'capillary attraction.' But this method is a very inefficient one; the bitumen escapes under the weight, because it does not grow hard enough to resist it, or it changes and combines with the lime. The best way is to interpose a layer of slate, held in the bed of mortar, between the first lower strata of

the sub-basement. The slate entirely arrests the effect of capillary attraction, and the moisture cannot ascend into the walls.

"Observe now this front wall on the court. It forms a sort of hump at the height of the first-floor staging. We say, therefore, that this wall 'bulges.' Instead of maintaining itself vertically, as ought to be the case, it is rounded. Why? Because it has been pushed by a force acting from the interior towards the exterior. What is this force? It might be a vault, but there is no vault on the ground-floor. It can only, therefore, be the staging. You scarcely understand, at first, how a staging, or flooring, which is horizontal, can push it out of place; for in order to push it, it must be supposed that the flooring stretches, in a certain sense, which is not possible. But see what happens. Formerly, in order to establish a flooring, thick beams were laid from one wall to the other, and upon these, lighter pieces of wood, called joists; then these joists were overlaid with a bed of earth, gravel, or sand, and above this an area of mortar was formed, to receive the pavement. All this is very heavy. Well, as a piece of wood, even if it be very square, bends, after a while, under its own weight, that is to say, straight as it is, becomes bent, so much the more will it become bent under a heavy burden. The more it bends, the more pressure it exercises on the interior facing of the walls in which it has

been fitted. It is this pressure on the interior facing which tends to push the wall outwards. But if, as here, to relieve the burden of the beams, you place underneath wooden trusses, this pushing effect is still more obvious, because the arm of the lever is longer. (Fig. 12.) A drawing will

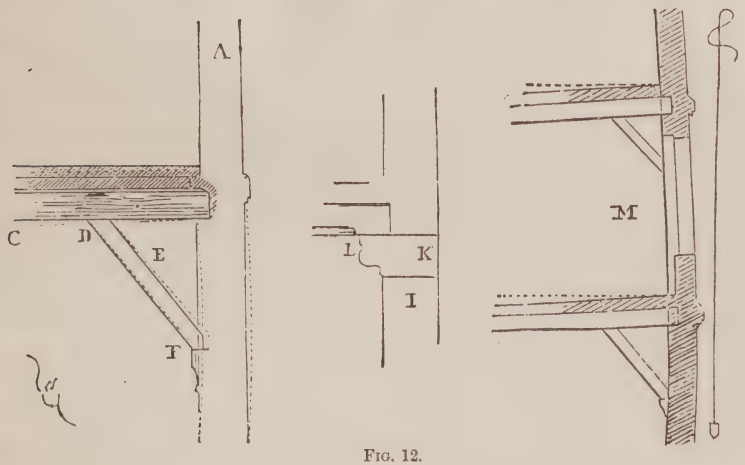


Fig. 12.

make this clear. Let *A* be a section of the wall, or, if you prefer, its thickness. If the beam bends at the line *C D*, it produces a pressure at *D*, which is betrayed by a pushing out at *F*, and the rounding of the wall indicated by the dotted curves. Suppose that, in place of the truss *E*, we have a stone corbel; the effect produced will be the same, but less powerful, unless the end of this corbel receives the whole thickness of the wall, as I show you in *I*,

and unless this end *K* is so weighted that the weight neutralizes the pressure caused by the beam at the extremity *L*. This has not been done here, where a corbel has been put in place of the wooden truss. This corbel has but a slight hold in the wall, and the wall, built of small materials, with bad masonry, has not sufficient consistency to resist the pushing caused by the rounding of the beams.

"But, you will ask, why is this effect produced at the height of the flooring of the first floor, and not above? Because, by the effect of the bulging which we observe here, the wall is inclined, above, towards the interior, and it has thus jammed in the second flooring, its facings being placed, by their inclination itself, perpendicularly in the curved direction of the upper beams, as I show you in *M*, where the effect is exaggerated so that it may strike you more forcibly.

"You see that each detail is worthy of attention, and that in building you must take account of everything.

"In all things, the only way to avoid an evil is to analyze and search for its cause, and to determine its effects; that is why it does not suffice, in order to be a good builder, to become familiar with the rules of construction, which cannot provide for all cases; you must see and observe much, and ascertain the defective points in old buildings; in the same way physicians learn to define a good physical constitution by studying maladies and their causes. We only appreciate,

most often, what is good by a knowledge of what is bad; so much so, that, in the absence of the bad, we can admit that the good exists. An old master architect, who desired to assist me with his advice, when I was about your age, often said to me, 'My friend, I can tell you what you must avoid in the art of building; as for telling you in what the good and beautiful consists, that is a matter for you to find out. If you were born an architect, you will easily discover it; if not, all that I could show you, the examples which I should display to you, would not give you talent"; and he spoke wisely. A sight of the finest achievements of the art may pervert the minds of students, if, in showing them to them, the master does not explain to them how the authors of these works succeeded in making them beautiful, because they avoided falling into such and such faults.

"But that is enough to fill up your day's report. Make fair copies of these sketches, in drawing it up, and we will look it all over this evening."

CHAPTER VI.

PAUL IS INDUCED TO ESTABLISH CERTAIN DIFFERENCES BETWEEN MORALITY AND HOUSE-BUILDING.

WHEN Paul's report of the day's lesson was read, that evening, in the family circle, M. de Gandelau interrupted the reading at the following phrase, incorrectly set down: "Good is only the absence of evil."

"Oh! oh!" said the father; "charity is something besides the absence of evil. If you give nothing to the poor man who begs bread of you; if, knowing how to swim, you do not try to save a man who is drowning, you do not do ill, neither do you do well."

"It is not quite what I said to Paul," replied the cousin, smiling. "Apropos of faults observed in constructions, I said, I think, that good is the absence of evil; that is, that, in building, and perhaps in many other things which belong to purely material order, to do well is to avoid that which is bad. I confess, besides, that I have not sufficiently developed my idea.

"Two things are necessary to become a good builder; an

exact mind, — which belongs to the moral nature of each of us, — and experience, which is acquired.

"The observation and experience which are the result, aid us to recognize what is bad, and avoid it; but if, in spite of this, one is not endowed with an exact mind, naturally regulated, experience, while enabling one to avoid what is bad, does not of itself suffice to discover what is good.

"Besides, if in morality good is absolute and independent of circumstances, it is not so in building. What is good in one place is bad in another, by reason of the climate, habits, and of the quality of materials and their adaptability to this or that local circumstance. If it is good, for instance, to cover a roof with slate in a moist and temperate climate, it would not be so in a hot, dry, and windy climate. Wooden buildings are excellent on some sites, bad on others. If it is good in dwelling-houses to open wide doors, and glaze large surfaces, in the northern climates, because the light is dim, this is bad in southern countries, where the light is intense, and where the heat must be guarded against. If, then, you can make a code of morality, you cannot establish absolute rules in building; since experience, reasoning, and reflection must always intervene, when a building is undertaken. Young architects have often asked me what was the best authority to consult on building. I have told them there was none, because a work could not provide for all cases, for all the special circumstances which come up in an

architect's career. A text-book furnishes rules; but ninety-nine times out of a hundred you find yourself dealing with the exception, and have no use for the rule. A book on building is good to accustom the mind to conceive and accomplish according to certain methods; it gives you the means of solving the problems proposed, but does not solve them, or at least solves only one in a thousand. It is, then, for intelligence and observation to supply in these thousand cases that which the rule could not foresee."

Third Lesson.

"Yesterday," said the cousin to Paul, when the latter entered his room, "we visited the cellar and ground-floor; to-day we will go through the garrets of the château. But first I am going to show you what is called a rib of framework. The most simple rib is composed of four pieces of wood: two rafters, one tie-beam, and one king-post (Fig. 13). The two inclined pieces, *A*, are the rafters, the horizontal piece *B*, the tie-beam, and the vertical piece *C*, the king-post. The upper ends of the rafters unite in the king-post, as I show you in the drawing *D*; that is to say, with the aid of two tenons *E*, which enter the two mortises *F*, and of a shoulder *G*, which causes all the wood-pieces to fit in the notch *I*, which we call 'franking.' The lower ends of the rafters unite in the same way with the two extremities of the tie-beam,

as is seen in *H.* The king-post is also united to the middle of the tie-beam by a tenon, but loosely, and without pressing upon the tie-beam. The tenons having entered the mortises, wooden pins are driven into the holes which I point out to

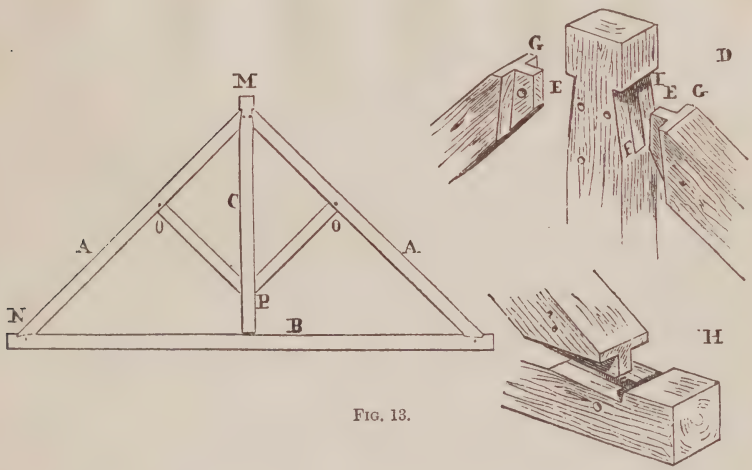


Fig. 13.

you, so as to hold the whole well together. The more you press upon the summit *M*, the more you tend to turn away the two rafters from the foot; but these being fixed at the two ends of the tie-beam, tighten the latter like the chord of an arc. Then this tie-beam is the less likely to bend the more it is strained, and the king-post is only there to hold it in the middle, and to unite the head of the rafters. But these rafters may bend under the weight of the roof, from *M* to *N*; therefore two trusses, *O P*, are added to arrest this bending, by carrying the weight upon the king-post, so that the latter

is in its turn strained from *M* to *P*. The wood cannot stretch, the point *P* is fixed, and therefore the two points *O* are also fixed.

"Now that you know what the most simple rib is, let us go up to the roof."

This roof was old, had been repaired and consolidated many times, and formed a piece of disordered carpentry work difficult to comprehend.

"Formerly," said the cousin, "more than a century ago, carpentry work was done as you see it here; each rafter carrying a rib; that is to say, each of the rafters composed a rib, excepting a tie-beam which was only placed at intervals. Then the wood was plenty, and there was no need of economizing it. Now it is less plenty, and it is difficult to procure a large number of pieces of considerable size. The fine old forests which covered the soil of France have been foolishly wasted, and extensive woods of oak are rare. They must, then, be economized. So it has become usual to establish firm ribs, at a distance from each other of about four metres. On these ribs purlins have been placed; purlins are the horizontal pieces which you see on this side; and on these rafters, more or less long, have been fixed, to receive the lath-work of the tiling and the bottom of the slate. But all roof-carpentry ought to be established on sleepers, which are those horizontal pieces that repose on the head of the walls, which bind and isolate the tie-beams from the masonry; for

you must observe that wood is indefinitely preserved dry by the free air, but decays rapidly in contact with a moist body like stone. You see this piece of wood partly in contact with the masonry; it is half reduced to rottenness, whilst the rafter above, which is in the free air, has a dry appearance, and is as pure from decay as if it were new.

"In former times they made the floorings by placing joists on beams and the walls. These joists and beams remained visible, as you can still see in the kitchen and the large room on the ground-floor which serves as a lumber-room. The air circulated among these woods, and they might last for centuries. But it was discovered that these visible pieces were not pleasant to the sight, that they were not clean, and permitted spiders to weave their webs in their interstices. Then they nailed laths under these joists, and covered the lath-work with a coating which we call the ceiling. The wood being thus shut in and deprived of air, became overheated, as the carpenters say, that is, it fermented, and rottenness soon attacked it; so quickly, that the floorings with visible joists, which had resisted the action of time for centuries, fell from rottenness very soon after being closed up. I will add that formerly, before using wood in building, they took the precaution of leaving it out of doors for several years, to submit it to the action of the rain and the sun. They even bathed it for a certain time in water, to purge it of sap, — sap being the ferment which causes the decay of the

wood. When the wood, stripped and cut in broad squares, had remained in the open air five or six years, it was used. But we live in faster times; and they now often use wood which has not been a year cut. It is not dry, retains its sap, and if it is then closed up it ferments rapidly, so that in a few years the largest beams become rotten. Prudent architects hesitate to employ wood for floorings. Still its use, even in a state of imperfect dessication, would not have grave results, if it were not closed up between coatings. The worst that could happen would be cracks and roundings. They would dry in use, as they would in the open air.

"There is, then, no great inconvenience in employing freshly cut wood for roof carpentry, which is usually left open. It would dry in its place. It would become distorted, but would not decay.

"As we should not be able to find perfectly dry wood for your sister's house, we will make the floorings of visible beams; and we will try, by simple and not expensive means, to give them an agreeable aspect.

"But you must know something of the various qualities of woods. I will not tell you that nature has nourished these great trees which we use, for our pleasure or our needs. Nature, I imagine, is scarcely occupied in knowing whether the oak or the spruce suits our purposes; and if human intelligence has known how to derive advantage from the materials which increase before our eyes, it is after having

recognized and established their properties by experience. Unhappily, it would seem that the results of this experience do not tend to increase; and to see the way in which wood is usually employed nowadays, it might be confessed that we are less instructed than our ancestors, or that we have lost the habit of observation with which they were familiar.

"Wood, being a composition of fibres more or less loose or compact, possesses a power of considerable resistance to a pressure which is exercised lengthwise on these fibres; but it bends or breaks easily, on the contrary, under a pressure exercised crosswise on these same fibres. Thus, a log of ten centimetres diameter and a metre long, placed upright, will support a pressure of twenty thousand kilograms,* without breaking or bending; whilst this weight would break or bend the log, if it were laid horizontally, as easily as you would break a rose-stem under your foot. Take a bit of good healthy straw ten centimetres long, and put your finger on one end, holding it vertically on a table; you will have to press hard to bend it, whilst the slightest pressure upon it when laid horizontally will flatten it. The straw is a tube. The tree is composed of a series of tubes one within another. The more numerous these tubes are, — the closer together and finer they are, — the more will the trunk resist pressure, whether in the length or the thickness. But this shows us that, in order to preserve the quality of resistance

* A kilogram being a little over two pounds three ounces.

in wood, you must use it as nature gives it; and thus it was used formerly. Each piece of carpentry was taken from a bit of tree more or less thick, but they did not saw the trees in their length to make several pieces of carpentry; for the core

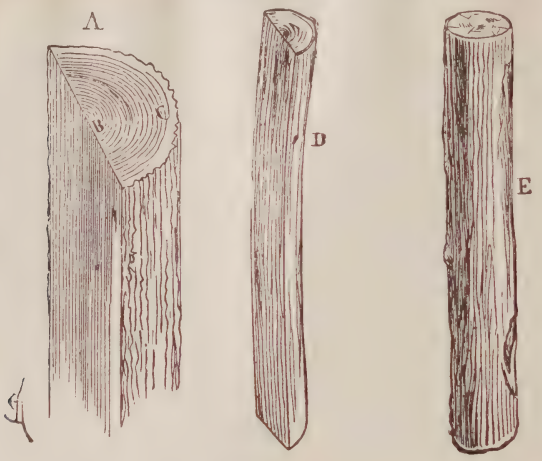


Fig. 14.

being harder and more compact than the sap-wood (which is the spongy envelope placed under the bark), and the concentric layers of the wood being the more compact and resisting as they approach the core, if you saw a tree in two in its length, one of the sides is much more resisting than the other, the equilibrium is broken, and under a weight a bending is easily produced. The exterior layers, being the most recent, are more spongy and loose in tissue than the older layers near the core; consequently the dessication, or drying, causes in these exterior layers a more considerable contraction than in the internal layers; hence, the bending (Fig. 14). Let

A be a piece of sawed wood; the layers *B* are harder and more compact than those, *C*, which contain more moisture and have softer fibres. In drying, this piece of wood will therefore produce a concavity on the exterior side, as I show you in *D*. If the wood is left entire, as in *E*, the effects will neutralize each other, and the piece will remain straight.

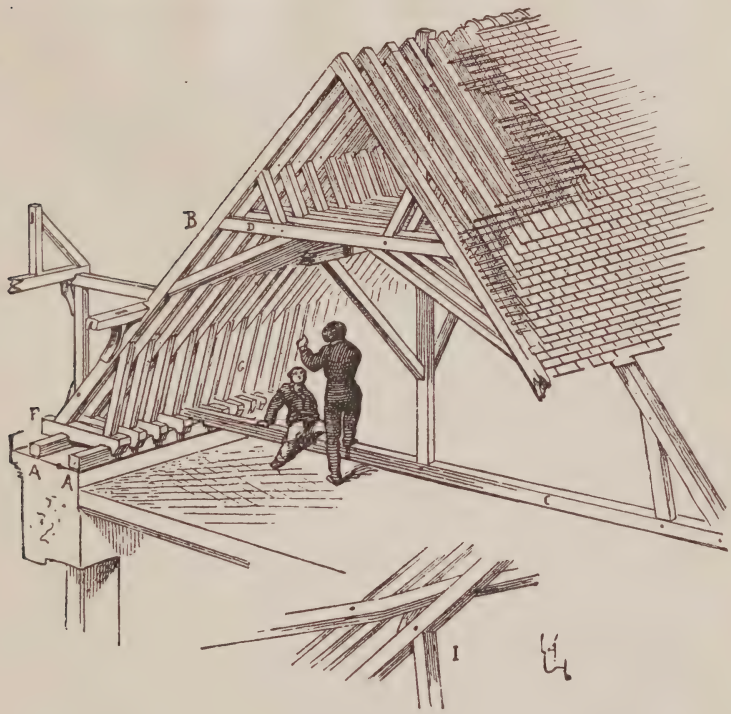


Fig. 15.

"Look at this old-fashioned carpentry, the rafters of which carry trusses (Fig. 15). The interties *A* were squared in pieces of oak, the core being in the centre. It is the same with the

rafters *B*, the tie-beams *C*, the false tie-beams *D*, the king-posts *E*, tie-pieces *F*, and the jambs *G*; all these parts have preserved their rigidity, and neither of them has bent, because they were used dry and in unsawed bits. Look, on the other hand, at this rib *I*, of a recent date; it is bent, not so much because of the weight of the rafters it bears, as because it is sawed and the carpenter has unskilfully placed the core on the inside. Had he done the contrary, had the core been placed on the side of the rafting, the rib would probably not have bent, and perhaps it would have even acquired stiffness, and become convex on its external side. But carpenters are men, and do not like to make work for themselves when they can avoid it. He who placed this rib has found it more convenient to place it according to his plane of sawing, rather than turn it and put this plane under the rafters.

"Considering this quality of wood, especially of oak, the internal fibres of which are harder and closer together than the outer layers, when they wish to place a piece of wood horizontally on two points of support or piles, and give it all the resistance of which it is susceptible, to carry a weight acting on its middle, they saw it in two in its length, and turning the faces to the exterior, pin together the two pieces, as I show you here (Fig. 16). Then the cores are on the outside, and as the two pieces tend to curve and thus to form two convex surfaces, as you see in *A* (Fig. 17), if they are well fastened with pins fortified by good plates, they are forced

to remain straight; the tendency to bend in one neutralizing the same tendency in the other, the two contrary efforts tend to give greater stiffness to the piece; as, if you take a wood

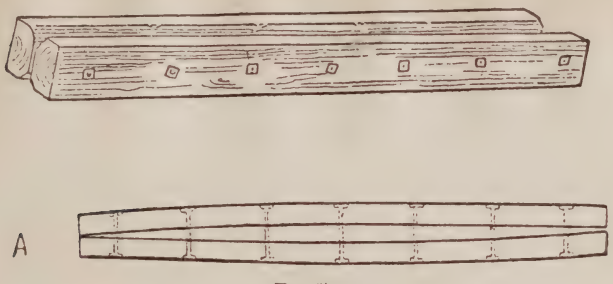


Fig. 17.

naturally somewhat bent, and place these two pieces so that the concavity shall be underneath, after having overlapped

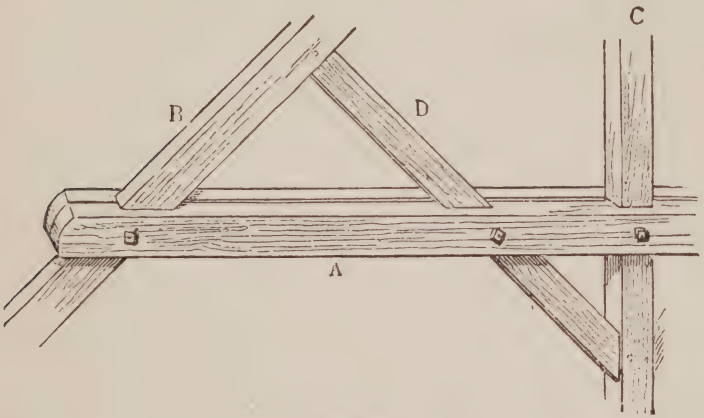


Fig. 18.

them, putting the end of one against the head of the other, you will give to this piece of wood all the resisting power of which it is susceptible.

"Couplings, and all double pieces, must be disposed according to this method. Here, for instance (Fig. 18), you see that they have rightly placed a pair of couplings, by putting the sawed parts on the outside, to replace a decayed tie-beam. We call pieces of wood which, usually double, hold fast two or several pieces of carpentry, couplings. These couplings *A*, by means of notches in the middle of the wood, hold the rafters *B*, the king-post *C*, and the two trusses *D*. Iron pins with screw-nuts exactly clasp the notches of the couples as jaws would do, against the pieces which they are designed to keep in place. But this is enough for to-day, and you will have enough to do to write out, between this and evening, our lesson in carpentry."

CHAPTER VII.

PLANTING THE HOUSE, AND OPERATIONS ON THE GROUND.

NEXT morning a letter was received from Madame Marie N——, dated at Naples, in which she expressed the liveliest and most patriotic apprehensions concerning late events. Paul's sister begged the family to join her at Naples; her husband could not just then return to France; the business which called him to Constantinople would brook no delay, and forced him to embark at once. The letter closed as follows:—

"We have received Paul's plan; it seems to us to have been somewhat assisted by our cousin. It would please us both very much, if ever it could be put into execution; but who could now, in our poor country, think of building? Come rather and be with us here."

"Well," said M. de Gandelau, after the letter had been read, "you see your plan is approved; let us proceed without delay to its execution. If Messieurs the Prussians come as far as this and burn our old house, according to their custom, they will not burn the walls of a building scarcely begun, and

what we have spent in erecting it will not go into their pockets."

The cousin, aided by Paul, who made the calculations, — he had never done so much before, — counted up the estimates, which reached the figure of 175,000 francs ($35,000). The earthwork and masonry entered into the foreseen expense at 85,000 francs.

Papa Branchu was called.

"He 's the right sort of man, your father," he said to Paul, when it was agreed that they should begin next day; "he gives people work when good workmen are turned away everywhere, and old fellows like me, who cannot fight, are going to starve all winter. I 'm going to drink his health with Jean Godard, the carpenter, who will be mighty well satisfied all the same."

The rest of the day was occupied in putting the principal numbers on the plan in order to be able to trace the excavations.

Early next morning Papa Branchu appeared on the ground, armed with cords, pickets, nails, pins, a large square, and a water-level, and was speedily joined by Paul and his cousin.

"You see," said the cousin to Paul, "that the numbers on the plan indicate the distances between the axes of the walls. Consulting them, we will plant these axes on the ground, by the aid of cords attached to what we call 'pins,' which are composed of two stakes fixed solidly in the earth, and of a

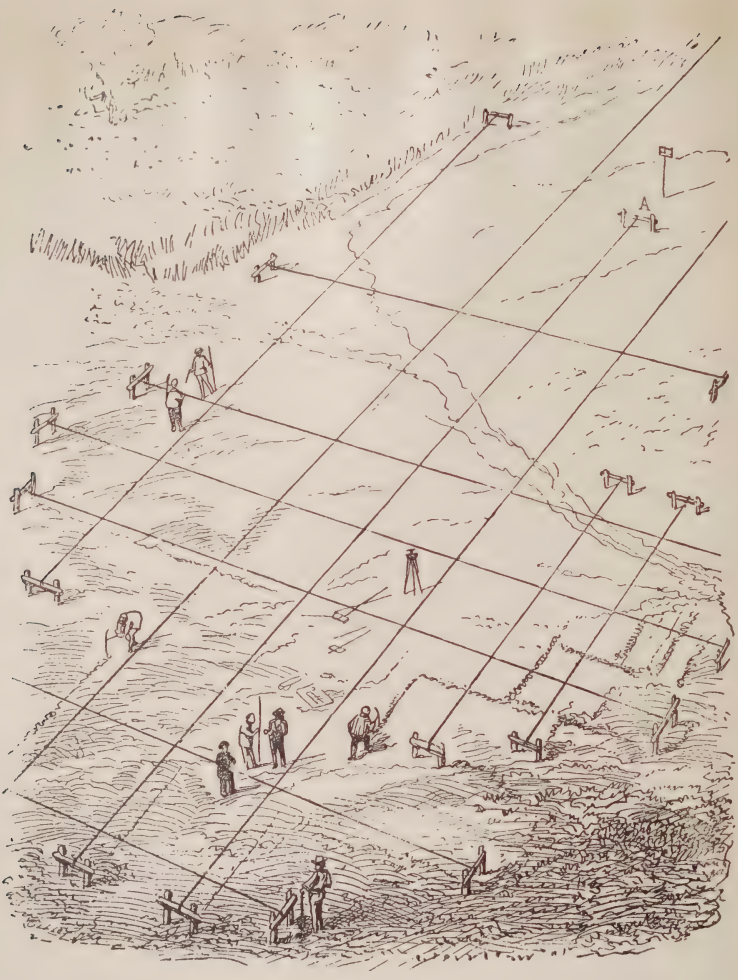


Fig. 19. — TRACING OUT THE SITE. — Page 87.

traverse. The direction of one of the axes being decided according to the aspect we wish to choose, the disposition of the others will follow according to the distances sketched on the plan, and the measurement of the square." (Fig. 19.)

The cousin soon decided on the line of axis *A*, for the dining and billiard rooms, according to the desired aspect. Then, on this first line, he established another at right angles, by means of a small graphometer, which was the line of axis for the drawing-room and the hall. These fixed, the others were disposed by means of the numbers previously written on the plan. The axes of the main walls were thus traced on the ground by cords fastened to pins.

As it was necessary to establish cellars under the whole of the main building, the cousin contented himself with ordering Papa Branchu to dig the whole ground at a distance of one metre outside of the lines of the perimeter. Two diggers, with their pickaxes, set to work to trace out the excavation.

"If you find, which is pretty certain," said he to the digger, "rock of a slight depth and of good quality, be careful and not botch it; work it like ashlar; we will make use of it, and pay you accordingly. If you find any blocks, get them out whole, and put them aside, so that the best pieces may be used. To-morrow or next day we will give you the plan of the cellars. Meanwhile supply yourself with bricks, lime, and sand; you know that in this country it is pru-

dent to look out in advance in order to have these materials in time. We are in September, and our cellars must be finished at least before the first frosts."

"So now," continued the cousin, speaking to Paul, as soon as they returned, "I name you inspector of works, and these will be your duties. You will come upon the ground every morning, and at first will see to it that the orders given in your presence are strictly carried out. Thus you will have to take account of the quantity of stone taken from the excavation, have it piled neatly on one metre in thickness, two metres in width, and an indefinite length, according to the production of the quarry. Having thus each day ascertained the augmentation of the cube, we shall be sure that nothing has been abstracted from it. You will have a memorandum-book in your pocket, in which you will set down this daily increase, and you will have Papa Branchu initial each page. This is only, for the moment, a supervision; but your duties will become more intricate as fast as the work advances. If materials arrive, you will take note of the quantity, in number, if they are bricks, and by the cube, if they are sand and lime. For this purpose I will have brought a laborer's box, a metre by a metre and a half high; this, being filled, will therefore hold a half a metre.

"You will say to Papa Branchu that he must erect a shed with planks, which shall serve as a depository for his tools,

and shelter the lime under cover until it is used up. If we had a regular contractor, or one with whom a bargain had been made, we should not have to bother ourselves about the quantity or cube of the materials brought on the ground; but here we are obliged to employ elementary means, for Papa Branchu cannot make advances of funds. We will give him the materials we purchase, or which come from our resources, on account. You perceive that these materials must not be taken away or wasted. We only pay him for the actual work. This requires on our part more attention and supervision, but we can be certain at least that we shall not be deceived in the quality of material by a contractor who would, perhaps, be interested in furnishing us with stuff inferior to that which we had bargained for.

"We will make a similar arrangement with the carpenter. Your father tells me that he has some pieces of oak, cut within a year or two, and stowed away at Noiret's farm. Let us go and look at them, and mark those which we select to use. Our numbered plan gives the lengths of the flooring-joists."

As they passed along beside the stream which trickled through the little valley, the cousin attentively examined its banks, and every now and then rapped the sides with the ferule of his cane.

"What do you see there?" said Paul.

"I think that we shall find good material here for making

the cellar vaults. You see this yellowish stone, as porous as a sponge. It is a present which the modest little stream makes us. It carries in its waters carbonate of lime, which each day incrusts itself on the grass and vegetable detritus which are on the borders and in its bed. This stream also forms a light, very porous 'tuf,' a calcareous rock, which is soft and friable as long as it remains in moisture, but on being dried acquires a certain hardness. Formerly this stream was larger than it is now, and it seems to have deposited a very good thickness of tuf, which appears on its present borders. Take this piece and examine it closely. You see that it is full of cavities, of small cylindrical galleries; here were twigs of vegetables, around which the carbonate of lime was deposited. These twigs have decayed and been destroyed for a long time; the envelope has remained and hardened in the air. Observe how light this stone is, being composed of cells which are scarcely thicker than egg-shells. But try to break it with your heel; it resists, and the pressure scarcely affects its sharp edges. Well, dry it, and in a week it will resist yet more; then it will require a heavy blow of the hammer to break it.

"This is perhaps the best material with which to build vaults, because of its lightness, resistance, its cavities, and a ruggedness which causes the mortar to stick so fast to the junctions that it cannot be detached, and that the whole, when sufficiently dry, seems to form but a single piece.

"We will send men to quarry several metres of it. This is not difficult: when the tuf is moist in its natural bed, it can be rapidly taken out in lumps."

They soon reached Noiret's farm; and there, sure enough, along the barn wall, under a shed, pieces of wood were piled up, cut in large squares and black from moisture. The cousin marked a certain number with his knife, leaving aside those which were crooked, knotty, or rolled.

"And what is a 'rolled' piece of wood?" asked Paul.

"Rolled woods are those the fibres of which turn in a spiral round the core. You see the fibres, which are not vertical, and form spirals more or less distinct, lose their property of resistance; these fibres, because of their irregular turning, become disjointed, and leave deep cracks between them. Such woods are therefore rejected as defective, as well as those which are attacked at the core, or which have diseased parts between their layers, called 'malanders,' these being a kind of interior ulcers which first take from the wood its solid resistance, and then develop decay in it. It often happens that the malanders are not visible, and then carpentry wood which seems perfectly sound falls to dust. As these diseases are frequent or rare according to the ground in which the wood grows, it is necessary to know the origin of the wood used in building. One forest produces oaks which have a fine appearance, but which rapidly decay; another furnishes oaks which are

always sound. In general, woods grown in light, dry soils are good; those which come from moist clay soils are bad.

"You will have these rolled and crooked pieces put one side, as they will be good for making the cellar arches; they will do for that, or for fires. As for these bits of spruce, they will serve to make our scaffoldings."

It was late, and the two companions breakfasted at the farm. While the table was being set, Paul said, "Explain to me, cousin, how you use the graphometer."

"It's the simplest thing in the world, in such an operation as we have just been engaged in. I asked Papa Branchu to have my instrument carried to the château, so as not to be bothered with it all the morning, but it is not necessary to have it here to show you how we operate. You know that the graphometer is composed of a graduated circle, divided into 360 degrees. This circle, movable on its centre, is provided with a spirit-level, and above with an eye-glass, both of which turn on a pivot at the centre of the circle. The level and the axis of the glass are exactly parallel with the plane of the circle. You place this on a prop with three legs, and first establish the circle horizontally by means of three screws and by turning the level on the pivot. The spirit must always be in the centre under some degree of the circle which the tube is turned to. This done, and the prop being placed at the point marked on the ground, which is verified by means of a plumb-line passing

by the centre of the plateau, the glass is directed to a fixed point where a stake is placed. The surface of the glass is crossed by two hairs, at right angles, which mark its centre. The intersection of the two hairs must fall on the point to be observed. But, previously, the indicator, or scale, at the base of the glass, is placed on the zero of the circle. It is then the whole of the instrument which has been turned. Then, if you wish, for instance, to form a right angle on the line uniting the point where you are placed with the first stake, you turn the glass until its indicator is at 90 degrees (a quarter of the circle). You send a man with another stake in the direction of the glass, and make him carry it to the right or left, until its middle is exactly on the line of the vertical hair on the glass. Then the stake is put down. It is then certain that the line drawn from the point where you are placed, to the second stake, forms a right angle with the first base line; since two diameters, cutting a circle divided into 360 degrees at right angles, give 90 degrees for each quarter of the circle. With the aid of this instrument, having previously indicated on the plan of the building it is intended to erect the angles which form certain lines between them, from a certain point, you can transfer these angles to the ground.

"Suppose you want to plant a semicircular portico. Having found the centre, and traced the semicircle on the ground, you can, by placing the graphometer on that centre,

determine the lines which will regularly cut the circumference, and would indicate, for instance, the axis of the columns of pillars. (Fig. 20.) As you have from the point *A* to the point *B* 180 degrees, you will divide these 180 degrees into as many parts as you wish on the circle of the graphometer, and the centre of the glass will give you, at a long distance, the same divisions on the semicircular portico.

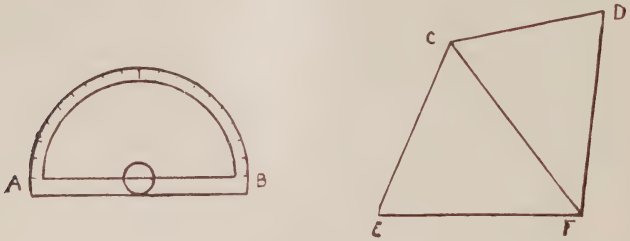


Fig. 20.

"In the same way that the graphometer serves for planting a building, it serves to take the bearings of a ground. Suppose that the base *E F* is of a known length, which has been measured; placing your instrument at *E*, you sight with a glass a point *c*, whether it be a tree, a steeple, or a picket; you have then the number of degrees, on the circle, which the angle *C E F* includes. You carry this angle upon your plan; then, carrying the instrument to the point *F*, you sight from thence the same point *C;* you obtain the same angle *C E F*, which, carried upon the plan, gives you exactly the position of the point *C*, and the unknown dis-

tance between *E* and *C*, between *F* and *C*; then one or other of these lengths serves you as a base in their turn, and operating from the point *C* or *F*, in sighting a fourth point *D*, you ascertain the lengths *C D* and *F D*. Thus you can operate all over a section of country; it is called 'triangulation,' the first operation in making a map. But here we come upon another subject. Come, let 's to breakfast."

CHAPTER VIII.

PAUL REFLECTS.

HIS ham omelet eaten, Paul remained silent.

"Why, little cousin, you seem to be rapt in something beyond the real world: are you still so hungry as to be pensive, and must you have another omelet?"

"No; I 'm neither thirsty nor hungry, but I find it already difficult to understand what you have been so kindly telling me the past four days; there are points which escape me, and I begin to wonder whether I can really be of any use in the construction you are erecting. It seems to me that I have much to learn; the little that you have taught me is all mixed up in my head, and we have not yet even set to work."

"Already discouraged, — come now! Each day suffices for its work, and a building is not erected so quickly that you cannot, each evening, add little by little to your practical knowledge without confusion. All this will classify itself in your head, for the head is a marvellous box; the more you fill it, the larger it grows; and each thing, classed

in the compartment which is destined to receive it, may always be found. The point is to well arrange the compartments, and only to place in them objects which have been scrupulously studied and tried.

"But it is necessary that the work done should be made plain each day, leaving nothing to the morrow. The task I set to you, that is, the daily verification of all that enters upon the ground, and the use of materials, which we call the 'attachments', is only a question of exactness and care. The chief thing is not to get behindhand. Two hours at most will suffice you each day for taking your notes on the spot; two more for writing these notes out. You see you will still have three or four hours to occupy yourself with the details of execution, and to run about the fields."

"Did you begin to learn architecture in this way?"

"O, by no means! On leaving college, I entered an architect's office, who for two years made me copy designs of monuments, of which I was told neither the age, country, nor use; then I had to color them with the tints. Meanwhile I followed courses of mathematics, geometry, and ornamental designing. Then I was able to enter the School of Fine Arts, where I did not learn much, but where there were exhibitions for obtaining medals, and, if one could, the grand prize. There I remained three years. Total, five years. Still, it was necessary for me to get my living, for I only had enough to pay my lodging and purchase clothing.

I had to get a situation, that is, work at so much an hour for a busy architect. There I made copies, and more copies, but sometimes certain details of execution; God knows how, for I had never seen the least part of a building executed!

"But my patron was not strict, and the contractors supplied by their experience what was wanting to these details. Seeing that all this would not lead me, by a short road, to learn my profession, and having inherited several thousand francs, I set out on a tour, to study the architecture of edifices already built, and not of those which were only shown to me on paper. I observed, compared, saw the practical working, visited edifices which were falling, so as to understand the causes of their ruin.

"By five more years I knew enough of my profession to try its practice. Total, ten years, and I had not built a niche for a dog. A protector procured me admission to an agency of public works, where I saw methods used which were scarcely in accord with the observations I had been able to gather in my studies of old architecture. If perchance I indulged in comments of this kind, they stared at me; and the result was that I did not remain long, especially as an excellent opportunity presented itself to utilize what I had learned.

"A large company was making constructions of some very important works. It had an architect who professed to build Roman edifices for them; this rather troubled them.

They did not deem it essential to erect in the valley of the Loire edifices recalling the splendor of Rome. I was introduced to the directors; they explained their plan to me. I listened, and worked like a negro, to acquire all that was needed to satisfy my employers. I visited works, consulted large contractors, studied materials; finally I furnished a first plan, which by no means pleases me now. The work was begun; close study, constant attendance on the ground, gave me what I was deficient in, so that my first operations met with approval. Most of the directors had city mansions and rural châteaux. I became their architect, and I had soon an excellent business, and more work than I could do, as I think one must always be studying, reasoning, and modifying; for the farther you advance, the more difficulties you encounter."

"How, then, is architecture studied?"

"Why, by practising it. At least, in France, they now employ no other method, and perhaps it is the best."

"But how do those learn to construct who do not go about the world, as you did, and who follow the usual instruction?"

"They do not learn how to construct. They are only taught to conceive and plan buildings that cannot be constructed, under the pretext of preserving the traditions of 'high art'; and when they are tired of putting these conceptions on paper, they are appointed to an agency, where they

do as you are going to do; only they do it with disgust, since they see clearly other methods."

"But in beginning as I am about to do, can I afterwards study the — what shall I say?"

"The theory, the art, in a word? Certainly, and much more easily, for the little practice you will have acquired in building a house, or in seeing it built, from the foundations to the summit, will enable you to understand much that, without practice, is inexplicable in the study of the art. This will give you the habit of reasoning, and of taking account of certain forms, certain arrangements enjoined by the necessities of practice; forms and arrangements which appear to be pure fantasies in the eyes of those who have no idea of these necessities.

"How do they teach children to talk? By explaining the rules of grammar to them when they are three years old? No; but by talking to them and making them talk, to express their desires and needs. When they can talk nearly as well as you or I, the mechanism and rules of language are taught them, and then they can write correctly. But before learning by what laws the words ought to be placed, and how to write to compose a phrase, they know the signification of each of them.

"If we had not in France very strange ideas about education, we should begin the study of architecture at the beginning, and not at the end. We should give the scholars

these elementary practical methods of the art of building, before making them copy the Parthenon or the Baths of Caracalla, which, in default of these first practical ideas, are only images to them; we should thus lead youthful minds to reason and recognize what they are wanting in, in place of exciting their budding vanity by exercises purely theoretical or artistic, when they cannot understand the forms given them as models."

"A house like that we are going to build is, it seems to me, a small matter," said Paul; "and such a construction can scarcely furnish information necessary to the erection of a great edifice."

"Don't think that, little cousin; construction, outside of a certain scientific and practical knowledge which you can study at leisure, is only a method, a habit of reasoning, an obedience to the rules of good sense. Well, then, you must have good sense, and consult it. Unhappily there is a school of architects who disdain this natural faculty, under the pretence that it hampers inspiration, — for we have visionaries, as there are among writers, painters, and sculptors; but if fantasy is permitted to men of letters and artists, as it hurts nobody, architecture is another thing; it costs dear, and it 's you and I who pay for it. We have, then, the right to consider it at least inopportune. You must as much exercise the reasoning powers and good sense to erect a house as to construct the Louvre, just as one can

betray tact and wit as much in a letter as in an octavo volume. The value of an architect is not measured by the quantity of cubic metres of stone which he employs. The size of the edifice is not the important thing."

"Thus you admit that it requires as much ability to build a small house as a great palace?"

"I do not say that. I say that the faculties, the reason, the just measure, the exact appreciation of the disposable elements and their wise use, are as much manifested in the construction of the most modest house as in that of the noblest edifice."

"I can, then, learn a great deal in following the construction of my sister's house?"

"Certainly. First, because one learns much when he has the will to learn; secondly, because in a house, as in the greatest palace, you must see pass before your eyes the whole operation of building, from that of the diggers to that of the decorative painter. Whether the carpenter makes twenty doors or two hundred, if you wish to understand the way of making a door, of building and setting it, a single door suffices; you have no need to see a thousand."

"Still, we shall not make doors here, for instance, like those which belong to the apartments of a sovereign."

"No; but the principle of structure is, or ought to be, the same in both; and it is when these principles are departed from that one becomes visionary and nonsensical.

When you learn how a joiner's door is made, you will see that its structure is according to the nature of the material employed; the wood, and the place where it is to be put. After that you can study how the masters have made use of these elements and how, without neglecting the principle, they have produced simple or very rich works; you can do like them, if you have talent, and seek after new applications. But before all, you must know how a door is made, and not copy at hazard, before acquiring this first practical knowledge, the various forms which have been adopted, good or bad."

Paul continued to be thoughtful all the rest of the day; it was evident that he caught glimpses of great difficulties, and that the building of his sister's house took troublesome proportions in his mind. Returning to the paternal mansion, he examined the doors, windows, woodwork, as if he had never seen anything of the kind; and the more he looked, the more it all seemed to him confused, complicated, and hard to comprehend. He had never thought by what artifices these pieces of wood had been brought together, and found no very satisfactory solutions of the questions which he proposed to himself.

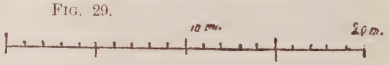
CHAPTER IX.

PAUL AS INSPECTOR OF WORKS.

"COME, my dear Paul, and see where the excavations are, this morning," said the cousin, the day after the visit to the ground, "and you shall give me an account of it. Carry with you a metre-measure and a memorandum-book; you will take notes and measures of what has already been done. You will examine the ground, and will tell me if any stone-banks are found near the surface of the soil, or if the movable earths are deep. Meanwhile I will sketch the plan of the cellars. But take a copy of the plan of the ground-floor of the house, and mark upon it what has been excavated and what is found there. The work cannot be far advanced; but some excavations, at least, will have been made, as I told Papa Branchu to put on it as many workmen as he could find, in order to carry out your father's intentions."

Paul, somewhat embarrassed by his new functions, soon reached the ground. Aided by Papa Branchu, he measured the excavations, indicated the depths as he could, and took note of the points where rock and loose earth were found. This occupied him for two full hours.

FIG. 29.



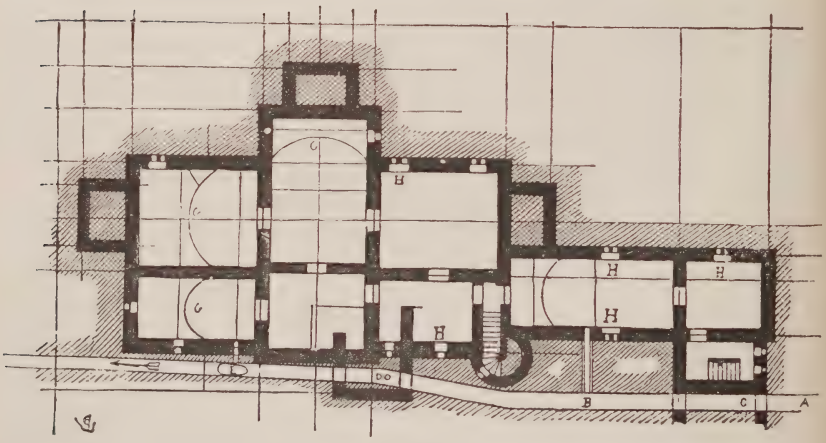


FIG. 21.

Fig. 21. — PLAN OF THE CELLARS, — Page 105.
Fig. 29. — THE GARDEN FRONT. — Page 122.

"Well," said the cousin, when they were seated in the working-room, "here is the plan of the cellars (Fig. 21). Let us see how this will be arranged with what you have found, and if we are to make any changes in it. Good! The rock is nearly on a level with the soil on the south, and the loose earth reaches pretty regularly a depth of three metres towards the north of our buildings. We will therefore place the cellars under the drawing-room, dining-room, and billiard-room, along the lime rock, which will be cut out, and we will establish the front parts, especially those of the stable and carriage-house building, on a good masonry-work.

"Here (Fig. 21) is the plan of the cellars; you see the lines of the axes; they indicate the axes of the ground-floor walls, and should not vary. The measurements of the thickness of the walls are written down, departing always from these axes. You see that these figures are greater where the cellar wall would carry the springing of the cellar vaults, according to what I explained to you the other day.

"We have a small watercourse which will supply the household needs, by means of a reservoir which we will place as high as possible. We have not yet established the levelling; but at a glance I should judge that, by reason of the fall of this stream and the rapidity of its flow, at one hundred metres from the house the reservoir will supply the water so that it may reach, by conduits, the level of the first floor. We must verify this. Otherwise we shall have recourse to

a pump worked by horse-power or a windmill. We will then conduct this watercourse in a sewer along the walls north of the house, as you see at *A*, so that this sewer will collect the water used in the house by a conduit, *B*, and will be connected with the water-closets at *C*, *D*, and *E*. The running water will thus carry off the impurities to a basin which we will establish below in the kitchen-garden. This rejected water is excellent for fertilizing the vegetables.

"On the plan, I have indicated at *G* the profiles of the cellar vaults. These will be 1 m. 50 c. to the beginning of the vaults, and the vaults will rise 1 m. 50 c. These cellars will therefore have three metres under the crown, which is very good. You can then use the cellars, not only for storing wines, but vegetables, a cupboard, and so on. The soil of our ground-floor being 1 m. 50 c. above the exterior soil, it will be easy to ventilate the cellars by vent-holes, as I have marked at *H*. You will descend to them by the staircase on the right, situated near the wash-house, and by the servant's staircase in the turret. The right-hand staircase will serve to carry down provisions, and the opposite staircase to carry up the wines and other things. Have you seen to it that Papa Branchu has had the materials, taken from the excavations, properly arranged?"

"Yes; he has so far only found some small pieces which he calls 'soft bed,' but he has had them piled up, and tells me they will be good for the foundation walls."

"He is right; this 'soft bed' is subject to the frost in the open air, but is hard and does well in cellars; besides, it permits good masonry, because it is in layers, that is, it is naturally taken out in little parallel pieces from ten to fifteen centimetres in thickness."

"That is what he told me; but he added that that consumes a great deal of mortar, and I don't quite understand what he means by that."

"Well, the smaller the stones the more layers of mortar they require between them; but if you have observed these pieces, you have seen that they are extremely rough, and riddled with cavities on their surface. The mortar must therefore be plentiful between each layer, so as to fill these cavities; and it is in this that the masonry, when the mortar is not spared, is excellent; the rough surfaces adhere to the mortar much better than smooth surfaces would, and make a solid body with it, and soon the whole forms a single mass. But you must not spare the lime and sand, and this is what made Papa Branchu say that this stone consumes a good deal of mortar."

"Papa Branchu also said that he had found some good stone for making lime, on the limestone-banks, proper to build with, and asked if he should put it one side."

"Certainly; if the lime-burner cannot furnish us with lime, we will make some; it is not hard to do, as we have plenty of fagots from the last wood-cuttings."

"Papa Branchu also asked me where the rubbish should be carried to."

"You will tell him, to-morrow morning, to dispose it in 'cavaliers' on the right and left of the excavations; we shall have need of it to level the approaches to the house."

"What is a 'cavalier'?"

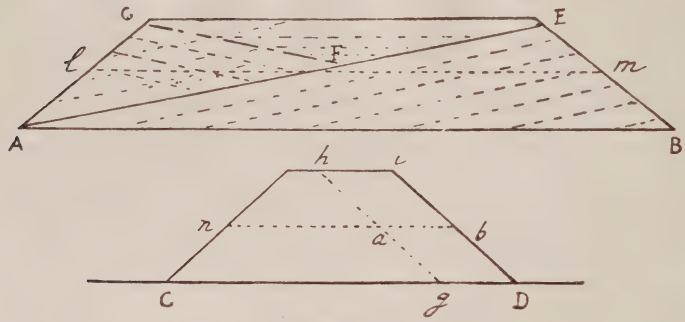


Fig. 22.

"It is an artificial mound which is deposited according to a regular height and thickness, so as to be able to take the cube of it easily. Thus when we take up the rubbish in wheelbarrows, — which is, as you have seen, the method we are employing, — the surface which the 'cavalier' is to occupy on the soil is traced out; let *A B* (Fig. 22) be the length, *C D* the width. This done, the point *B*, being farthest from that where the rubbish is taken, the barrow-men dispose the first earth at *B*, leaving to the embankment an inclination sufficiently slanting that the barrows may be wheeled full without trouble. Thus, little by little, they obtain an embankment *A E B*. Then from the middle *F*,

half of the slope *A E*, they leave a path *a b*, of a width of 1 m. 50 c. for the going and coming of the barrows, and then they fill up the triangle *A G F* with sloping beds. They end by filling the triangle *G F E*. There remains the path *g d h i* to fill, which is done with shovels, as fast as the earth is carried upon it. The 'cavalier' being thus perfectly regular, its slopes are given by the slipping earth, that is, they form angles of nearly 40 degrees with the horizon, according to the nature of the embankment. This being finished, and having, let us suppose, 10 metres of mid-height, from *l* to *m*, and 4 metres of mid-height in its width, from *n* to *b*, by multiplying 10 metres by 4 you get 40 metres of surface at this mean level. Multiplying this figure by 2 metres, the height of the 'cavalier,' we find 80 cubic metres. You know, then, that you have moved this quantity of earth, and what consequently you have to pay, if you remove your rubbish and embankments by the cubic metre; or at what price you get the cubic metre of removed earth, if the work is done by the day."

"And does this cube give that of the excavation?"

"Not entirely. The compressed earth, packed down on the natural soil, cubes less than that which has been removed, and leaves many spaces between the material of the embankment. We say, then, that the earth carried off 'abounds' more or less. Sea-sand does not 'abound,' whilst pebbly earth, mixed with vegetable detritus, 'abounds' a good

deal. You must then, in your reckoning, take account of the void in the excavation, to get the cube of the earth removed, and cube the 'cavaliers' so as to know, when we use them, the mass of earth which we shall have to carry elsewhere.

"Now, put this plan of the cellars to a scale of two centimetres per metre, so as to be able to write the figures legibly; then I will show you the points on the plan, where the rugged ashlars must be put."

"What are the rugged ashlars?"

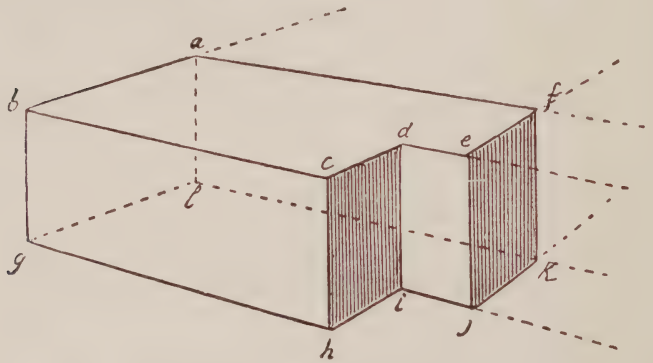


Fig. 23.

"The cut stone is so called, which is placed at the foundation, and which is only cut on its layers, that is, which has not visible faces. A cut stone always possesses two layers, which are its horizontal surfaces; one or several faces, which are the visible surfaces, and its joinings, which are the separating surfaces. Thus let us suppose an angle stone carrying a pilaster, and having the form which I in-

dicate here (Fig. 23); the surfaces *a b c d e f, g h i j k l* are the upper and lower layers. The surfaces *a l b g, b g c h, c d h i, d e i j* are the visible faces, and the surfaces *c f j k, a f k l* are the joinings, the neighboring stones touching these surfaces. You perceive that, when stones are placed under the soil, in the foundation, it is not necessary to cut the faces, which would only be visible to the moles. The cutting is therefore economized; that is, the stone is left uncut on its vertical faces and on its laid-down layers. They choose for these rugged ashlars solid stones, resisting burdens, but which in other places would be affected by frost, and which could not be used well in the open air; under ground, they are preserved from the action of the frost. But you must be cautious, more so with regard to these stones than those used in the elevation, to place them according to their quarry layers and their natural stratified position; otherwise they might break, or be crushed under the weight of the masonry above.

"When our plan is finished, we will indicate the places where the rugged ashlars should be put by a particular color. These will be the angles, the junctions of the walls which receive the relatively heaviest weight. Between them the masonry will be raised simply with ashlar stone.

"The soil being good, we will content ourselves with making the foundation at fifty centimetres only below the area of the cellars. But when we shall have reached this

level, the cut stones will necessarily have visible faces in these cellars; these materials will no longer be rugged ashlars, but cut stones. We will not take the finest and best looking, but those which will best resist the weight, and which, in this country, are the coarsest of aspect. We will put cut stone at the angles of our cellars, at the jambs of the doors and vent-holes, and at the newels of the staircases.

"But you have enough work for to-day, and to-morrow morning — Oh! I forgot. If Papa Branchu meets with springs or leakings which bother him, let me know, and we will at once establish channels to collect them. This will enable us to fix upon the level to give to the floor-bottom, or 'radier' of our collector."

"What is a 'radier'?"

"It is the part of a canal, sluice, or sewer, upon which the water runs; the bottom, which should be established so firm and solid that the force of the current will not wash it away. The beds of sewers must therefore be made of good flat stones, or, better still, of hydraulic cement when it can be procured, as the water finds means of passing between the joinings of stones, while if the cement is skilfully used, it forms, throughout the length of the canal, a perfectly water-tight homogeneous mass. They take care, besides, to give to the floor-bottom of a sewer a slightly concave form, joined at the sides without angles; for water

profits by angles to carry on its work of destruction. Besides, angles, when you wish to clean out subterranean canals, are not easily cleansed. The best form to give to a sewer is that of which a section is given here (Fig. 24)."

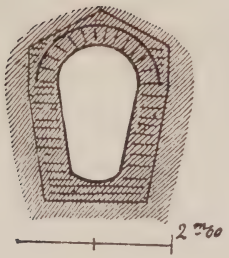


Fig. 24.

CHAPTER X.

PAUL BEGINS TO UNDERSTAND.

DESPITE the news of the war, which became daily more grave, M. de Gandelau insisted that the work should not be interrupted, and the occupants of the château found a useful distraction from the sad thoughts of the conflict in the execution of the projects arranged by Paul and his cousin.

In the evening, after the reading of the paper, which, alas! recorded disaster after disaster, all remained silent, with eyes fixed on the hearth; but soon M. de Gandelau, by an effort of will, forced himself to ask how the house was getting on. Paul, in his capacity of inspector of works, gave an account of the operations of the day, and began to acquit himself of this task with no little clearness and exactness. He showed his memoranda of calculations, which, thanks to his cousin's corrections, were not badly made up, and which, by aid of the daily review, indicated the expenditures made. The soil excavated had so far furnished enough materials to avoid the necessity of resorting to other quarries. About the 15th of September, the cellar walls

began already to appear in the excavation, to construct which wooden centrings were necessary. The carpenter was asked to bring sawyers to cut up the poplar trunks, which, having been for some time cut, were held in reserve. The best part of the wood was sawed in thin planks to make scant-

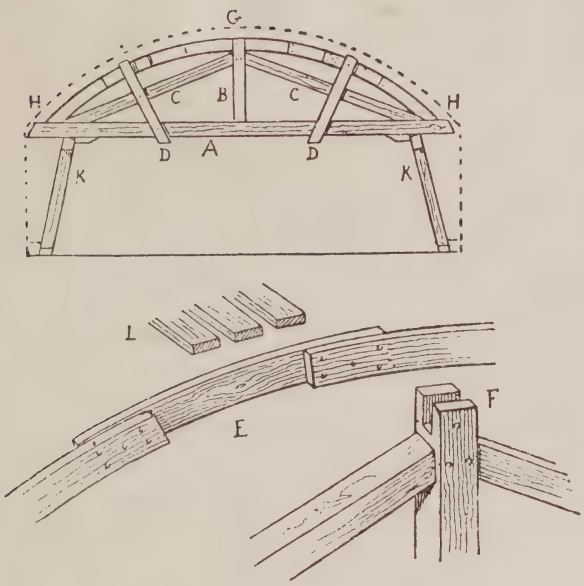


Fig. 25.

ling, which would be used at the proper time, and the "slabs," that is, the parts near the surface, were disposed to make the centrings of the cellars. As the plans only gave two vaults the arches of which were different, the diagrams were soon made, and the carpenter prepared the centrings, which were raised at the moment the cellar walls

reached the level of the springing of the vaults. These centrings were cut conformably to Fig. 25, that is, each composed of a tie-beam *A*, a king-post *B*, two rafters *C*, and braces *D*, which held fast the curves formed by the nailed slabs of poplar, as shown in *E*, and fixed at *G* and *H* on the king-post, by means of a mortise *F*, and on the tie-beam by an iron pin. On these centrings, carried on the beams *K*, and having a space between them of 1 m. 50 c., were placed bolsters, that is, joists, *L*, 8 c. thick, to receive the vaults made of tuf taken along the stream, to which a thickness of 20 c. was given, with a good cope of mortar above. It was necessary to provide, in the haunch of the vaults, spaces for vent-holes, a task which gave Paul a good deal of trouble, or rather which was difficult for him to understand and arrange in his calculations; as for Papa Branchu, he did not seem to be much disturbed by it.

His cousin had given the tracing of the vent-holes, at the same manner as the profile of the sub-basement, a height of 1 m. 50 c. above the exterior soil.

This tracing gave a plan *B* and a section *A*, as in Fig. 26. It was necessary for the cousin to explain this tracing to his inspector, who did not at first sight comprehend it.

"As the light comes from the heavens," said he, "according to a mean angle of 45 degrees, it is according to this angle that the cellars must be lighted. As the sub-basement composes a course *D* placed half under the soil, two free courses

E F, and a retreating course, we give to the cellar wall, carrying the springing of the vaults, 90 c. The wall above the interior soil having 60 c., this wall gives 30 c. on each side of the fixed axis; but the sub-basement having an

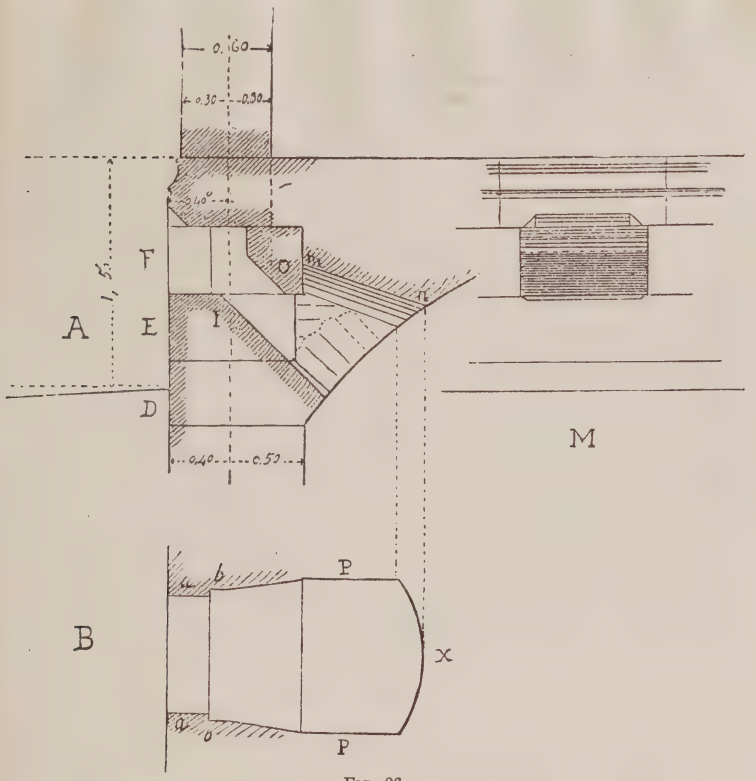


Fig. 26.

exterior of projection of 10 c. there will be 40 c. from the axis to the exterior face of this sub-basement. On the interior the wall descends directly to the 'summer' which carries the vaults. You must have 20 c. to receive the latter.

Then from the axis below the springing of the vaults there will be 50 c. on the interior and 40 c. on the exterior; total 90 c. The low course disengaging itself above the exterior soil at 15 c., since the sub-basement must have 1 m. 50 c., there remains above these 15 c., 1 m. 35 c.; which figure, divided into three, gives for each course 45 c. I take the opening of the vent-hole in the second course. I cut the third 10 c. by a chamfer, to get the light, as the exterior face *M* shows. I cut the first retreating course at 45 degrees, as traced at *I*, leaving a clear piece *a*, of 25 c., as you see it on the plan. Behind this I place a lintel with a chamfer, as it is traced in *O*, and I take care to leave two 'rebates' of 5 c. in *b*, to place frames or bars if desired. I splay the vent-hole from the bottom of these 'rebates,' with an opening of only 80 c. on the exterior, to a metre. I trace in section an inclined line *m n*, at 20 c, above the lintel *O*, which 20 c. shall be the rise of the vaulting arch which will penetrate the vault, and the curve of which in a horizontal projection will give the tracing *X*. Thus this arc *X* will receive the thrust of the key-stone of the vault, and will carry it upon the two cheeks *P*. Papa Branchu will have only traced this curve *X* on the bolsters of the centring to form his vaulting."

It was not certain that Paul quite seized this explanation, though several times repeated, and he did not wholly comprehend it until he saw Papa Branchu do the masonry work

on the vent-holes, and these appeared with the centring taken away (Fig. 27).

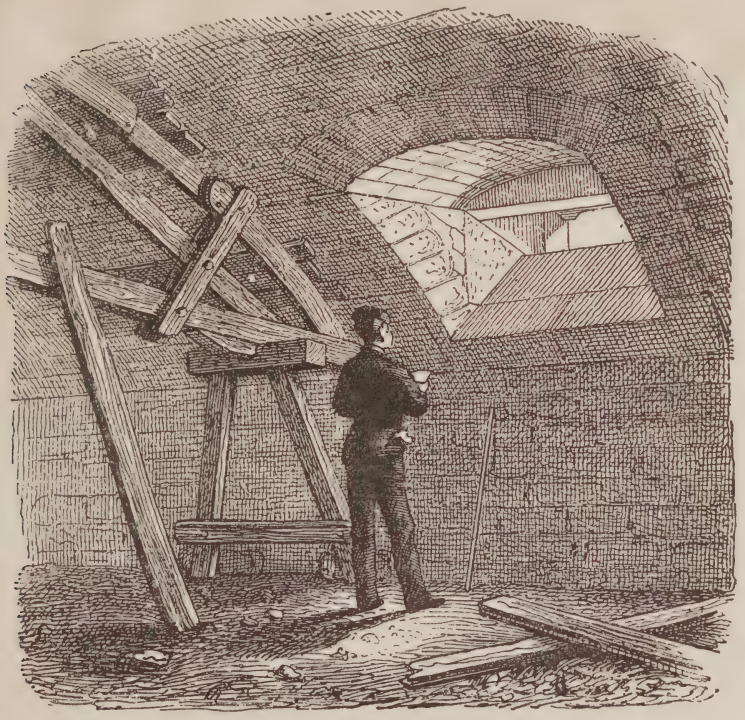


Fig. 27.

"I spare you the details," said the cousin, who saw that Paul scarcely comprehended the construction of the cellars, "for the structure of the vaults, of their penetrations, is a matter that calls for long study. We have only made simple vaults, and you will observe that the doors of the cellars all fall upon tympans, and not upon walls receiving the springing of

the vaults. I avoid useless expenses with the difficulties. We will put hard stone in the sub-basement, but you will remark that, excepting in the angles and for the vent-holes, it is only in the casing, it does not make 'through stone,' that is, does not take the whole thickness of the wall. We have excellent ashlar, which, with the good mortar we use, is more resisting than is necessary to carry two floors and a roof. By letting this ashlar form projecting toothing-stones on the interior, we shall unite it better to the haunches of the vaults (Fig. 28),

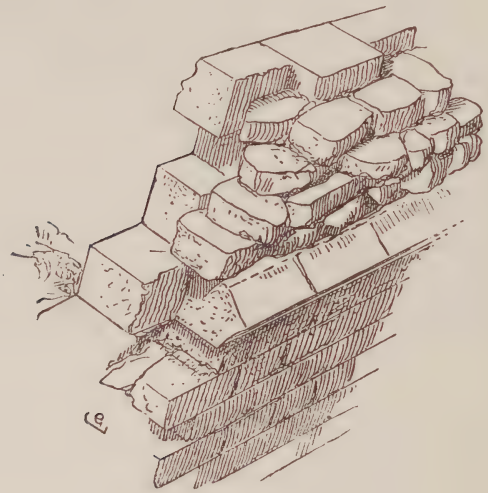


Fig. 28.

and we shall thus economize the freestone. In elevation, above the basement, you will see how, when you wish, you can spare the freestone, while making excellent constructions. We find,

besides, on the neighboring plateaus, thin lime-banks, which are unbedded regularly, following a height of 15 c. to 20 c. and which are excellent 'scappled stone.' 'Scappled stone' is that which is placed with visible facings, layers, and joinings cut in a somewhat rustic manner. Behind this faced stone, which gives a small dressing agreeable to the eye, and the rusticity of which contrasts with the purity of the freestone, they put ordinary ashlar. This is obtained in places where this ashlar is found naturally in quarry, an inexpensive sort of masonry. But it is foolish to amuse yourself by using picked ashlar, where freestone abounds, and where it must be cut in small pieces to obtain this appearance. You see that this is not to act according to common-sense, to cut big blocks of stone into small pieces, and that when the quarries yield only the former, it is wise to use them by reason of their dimensions, and to conform the construction to the nature and height of these stones. Here we have, when we choose to ask for them, large blocks, but they are not plentiful. We ought, then, to keep as far as possible to the quality of the materials which the soil furnishes us with in abundance."

The sewer was completed and the vaults closed in; the descents to the cellars were placed; the basement rose to more than a metre above the soil. It was time to study the details of the elevations. That upon the garden was only projected in outline. Paul hoped that it would have a more regular aspect than that upon the front. He spoke of this,

for he had seen a number of country-houses near Paris which seemed to him charming, with their four "pepper-boxes" with angles, their porches in the middle of the front, and their zinc ridges on the roofings. He had too good an opinion of his cousin's learning to criticise the façade of his sister's house, as it had been projected for the entrance front; but in his mind, he would have preferred something more in harmony with the laws of symmetry. These openings of all shapes and sizes somewhat offended his taste. When the fronting on the garden was traced, which, for once, presented a symmetrical aspect (Fig. 29), Paul declared himself satisfied with it; and when the family came together in the evening, he asked why the entrance fronting did not have the same symmetrical arrangement which was so agreeable on the side of the garden.

"Because," said the cousin, "the plan gives us, on the side of the garden, rooms in counterpart, the dimensions of which are alike and the design the same, while on the side of the entrance we have, next to each other, very different apartments. You are now raising, little cousin, a grave question. There are two methods to follow. You either project a symmetrical architectural box, in which you try, as well as you can, to distribute the apartments necessary to a residence; or you dispose these apartments on the plan, according to their importance, their relative position, and their relations to each other; and you erect the box by reason of these apart-

ments without seeking to obtain a symmetrical aspect. When a great edifice is to be erected, the exterior aspect of which must preserve a grand unity, it is well to try to satisfy the laws of symmetry, and not to give the edifice the appearance of having been built of bits and pieces. In a private residence, the imperative rule is to first satisfy the needs of its occupants, and to make no useless expenditures. The residences of the ancients, as well as those of the Middle Ages, are not symmetrical. Symmetry applied at all hazards to private architecture is a modern invention, a matter of vanity, a false interpretation of the rules followed in the best periods of the art. The houses at Pompeii are not symmetrical; the villa, or country-house, of which Pliny has left us a full description, does not give a general appearance of symmetry. The castles, manors, and houses erected during the Middle Ages are anything but symmetrical. You may visit, in England, Holland, Sweden, Hanover, and a large portion of Germany, a number of habitations marvellously adapted to the needs of their dwellers, which are constructed without regard to symmetry, but are none the less comfortable and pleasant of aspect, for the reason that they clearly betray the purpose for which they were built.

"I know that a good many people are willing to suffer a daily inconvenience to have the vain pleasure of displaying, outside, regular and monumental fronts: but I don't believe your sister is one of them, and that is why I did

not hesitate to follow what seems to me the law of common-sense, when we planned her house. With her quiet and slightly ironical smile, she would ask me, 'Why, dear cousin, have you pierced so large a window in this little room?' or, 'Why have you not opened a bay-window on this side, where there is such a pretty view?'

"If I replied that it was to satisfy the rules of symmetry, her smile would probably broaden into a free fit of laughter, and perhaps she would think that Monsieur her cousin was a fool with his laws of symmetry."

"Alas!" said M. de Gandelau, "those who consider matters of vanity before everything are but too numerous in our country. To make a display is the great thing; the retired petty tradesman, who builds a country-house, wants his turrets placed regularly at the angles of a symmetrical building, where he is very poorly lodged; he desires that the uncomfortable place should be called 'the château'; and he will sacrifice interior comfort for the satisfaction of displaying, outside, bad plaster sculptures, zinc ornaments on the roof, and a lot of gewgaws which must be renewed each spring. Let us make, dear cousin, a good house, well sheltered from sun and rain, quite dry within, and where nothing shall be conceded to this false luxury, a thousand times more offensive in our country districts than it is in the city."

CHAPTER XI.

BUILDING IN ELEVATION.

"IT is agreed that we shall build our outside walls with freestone and picked ashlar," said the cousin, while they were levelling the ground-floor. "We have a good part of the materials on the soil. We will bring the stones of large pattern from the Blanc quarries, which are only a few kilometres from here. Our angles, door and window frames, our borders, cornices, dormers, gable-copings, shall be made of freestone. Let us begin with the angles. This is how you will order Papa Branchu about the dressing of the stone; it is very simple. In this part of the country they cut pattern-stones; that is, the quarries send them according to a measure given in advance, and the price is less per cube according as the cutting is more uniform and easy. Now our walls are 60 c. in thickness in the height of the ground-floor. Let *A* (Fig. 30) be an angle; you will order all the stones for erecting them from the same pattern, with a length of 85 c. by a width of 60 c., and a mean height of 46 c., which is the ordinary height of the quarry banks in this vicinity. These angle stones will be placed as

I show you here, one *a b c d*, the other, above, *a e f g*, whence it will result that each stone will form alternately, on one

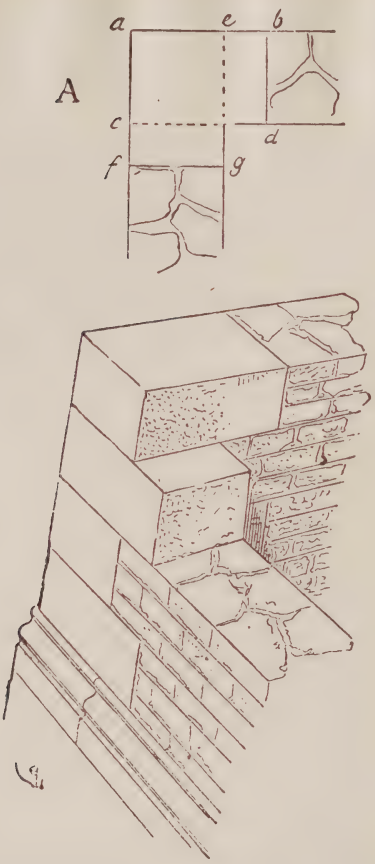


Fig. 30.

side and the other, a toothing-stone of 25 c. The scappled ashlar having a bank height of about 15 c., we shall have

three ranks of this ashlar in the height of each stone course, and the construction will rise as indicated by the perspective tracing *B*. Between the footing and the bordering of the first floor we have 4 m. 20 c.; thus nine stone courses, besides the layers, will make the height. Let us see how we shall dispose of our window-frames. We must keep the placing of blinds in mind, as these cannot be dispensed with in the country, and cannot be put on the front without a bad effect, besides that they would quickly deteriorate, would be hard to open and shut, and would impose on the occupants the necessity of a rather unpleasant species of gymnastics. There must be sufficient splayings on the interior, so that the casements shall not flush the walls, and shall leave a space between them and the curtains. Our largest windows are 1 m. 26 c. between the frames; our ground-floor walls are 60 c. in thickness; we can only, then, range the blinds in the frames by dividing each of their wings into two or three leaves. Sheet-iron blinds alone will enable us to obtain this result, since three sheet-iron plates folded on each other, together with the spaces left for the working of the hinges, have only a thickness of 5 c. Observe, then, how we trace the window jambs (Fig. 31); the outside being at *A*, we will leave a strengthening piece *B*, to mask the leaves of the blinds folded in the frames, of 10 c. We will give 27 c. for the lodgement of these leaves in *C*. Then will come the window sleeper, 6 c. in thickness; total, 43 c. There will then remain 17 c. for the splaying on the interior, at *D*.

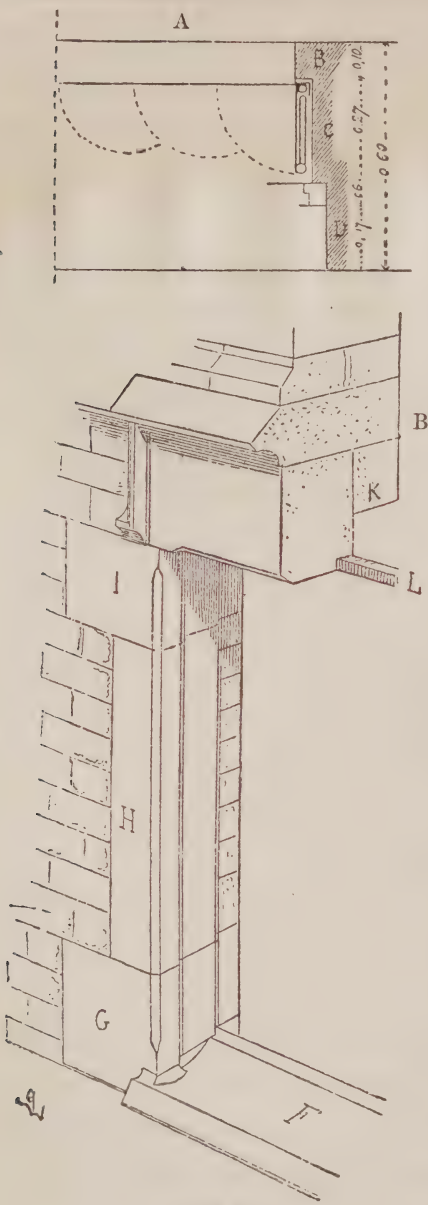


Fig. 31.

"Observe, in *E*, how we shall dress these openings; a supporting stone in one block, at *F*, then a course *G* of from 40 c. to 45 c. in height, making a toothing in the ashlar; a soft stone, *H*, having only the same thickness as the frame; a third course, *I*, like *G*; finally, the lintel. We will only give this the thickness of the frame, that is, 37 c.; there will remain to us, behind, 23 c. exactly in the place to key in a brick arch *K* (the bricks being 22 c., and with the joining, 23 c). This arch will carry our joists, if there are any to be put in on the front walls, and it will prevent the breaking of the lintels. Besides,

we will pass a grappling, *L*, under the latter. I find a grappling more effective at this level than at the height of the ceiling. A grappling is an iron sinew which is placed in the thickness of walls to bind and clinch the whole construction. It is not always placed in houses built in the country, but this is wrong, and very poor economy; an ungrappled construction is liable to crack easily. But we will speak of this again at the proper time. Make fair copies of these sketches and let me see them, and we will give Papa Branchu the details we have gone over.

"It is necessary to know how to make the ceilings. At Paris they nowadays make all the ceilings of iron, double T square, and for spans of 5 to 6 metres they take iron of 12 c. to 14 c., the vertical section. They 'pug' or rough-wall this iron spaced at intervals of about 70 c., and united from metre to metre by square iron cross-pieces of 0.018 m., by fillings of thin plaster work; this is certainly good, but we have here neither the iron, easily procured in the great centres, nor the plaster of Paris, which is somewhat misused, perhaps, at the capital, but which is none the less an excellent material, especially for interiors, when wisely employed. We must make our ceilings of wood. But I have already told you that wood which has not been long bathed in water, and has been scarcely two years cut, rots very rapidly when closed in, especially at its extremities fixed in the walls. We will adopt, then, the ashlaring system applied to the walls, to receive

the ends of the joists, and as we possess unhewn timber, we will content ourselves with dressing it with the saw on two faces, and we will place it diagonally as I show you here (Fig. 32). For the spans of from 5 to 6 metres, which are

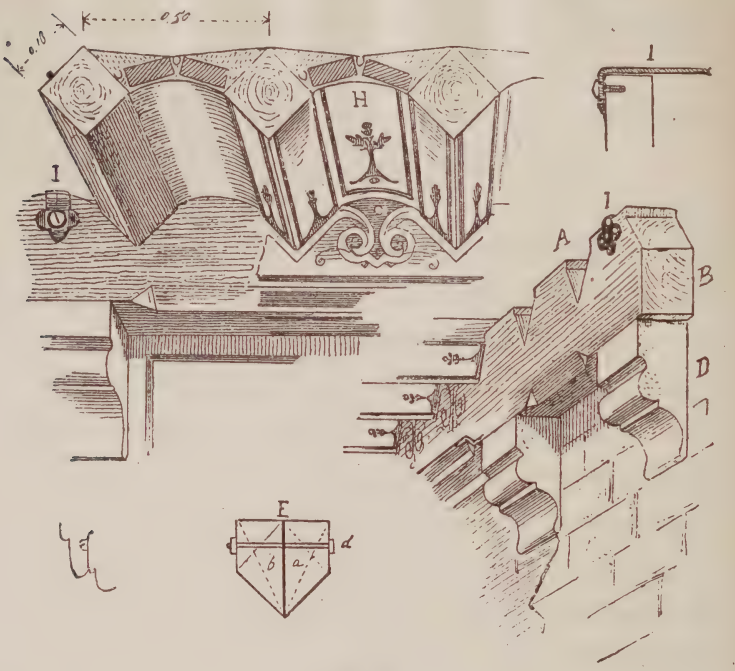


FIG. 32.

the largest that we have, square wood of 18 c. will be sufficient. If we judge that they are not, we will establish an intermediate beam; this remains to be seen. These joists, placed on their diagonal, have always their highest resisting power at the bending. We will space them, from axis to axis,

at 50 c. Their extremities will lie in the notches, or mortises, in the ashlaring, as I show at *A*, and the interjoists, which are the intervals between the joists, shall be composed of bricks laid flat, pugged with mortar and coatings. These ceilings may be decorated with painted fillets, making them light and agreeable to the eye (as seen in *H*). The joists thus established do not give re-entering angles difficult to keep clean and between which spiders spin their webs.

"As for the ashlarings *B*, applied against the wall, as the section *C* shows you, they will be held in place by small corbels *D*, spaced at one metre at most, and by fastening cramps *I*, to prevent an inclination of the wood. This will take the place of those plaster cornicings, which are good for nothing, and which we could not conveniently put up here, where we have no good plasterers. When it becomes necessary to support the upper partitions, we will place an exceptional joist, a section of which I trace in *E*, composed of two pieces *a* and *b*, with a hoop-iron between, the whole held by bolts *d* from distance to distance. These kinds of joists are of a perfect rigidity.

"As the joists rest upon ashlarings, we have no need to trouble ourselves about openings; but we must have 'trimmers' on the right of the chimney shafts and under the hearths; and to receive these trimmers, binding-joists You will see that pieces of wood cannot be placed without danger under the hearths; so, on the two sides of the rising of the

chimneys, at a distance of 30 c. of the hearthstones, stronger joists are placed, which receive 80 c. or 90 c. of the wall; and to clear the width of the hearth, a piece called a 'trimmer,' in which are gathered the joists.

"As binding-joists, we will take the type before indicated at *E*; we will reinforce (Fig. 33) this joist at its extremity, by a lining *D*, resting upon a good stone corbel. We will unite the two pieces *E* and *D* by an iron strap *F*; then we will join the trimmer by a tenon *H* in the mortise *G*. This 'trimmer' will receive, like the ashlarings, the extremities of the joists at *I*. The space *G K* will be below the hearth of the upper chimney; it will be 80 c. in width and will be pugged, with brick, to the iron interjoists *L*. The binding-joists *E* should be inserted in the wall about 10 c. to stiffen them and unite the structure; but in the neighborhood of the chimney shafts we do not have to fear the effects of moisture on the wood. Here (Fig. 34) is the aspect of these joists and 'trimmers' under the chimney hearthstones."

All this, it must be confessed, seemed somewhat strange to Paul, accustomed to the unchangeable solid and white ceiling, and never before suspecting that these simple surfaces could hide so complicated a structure.

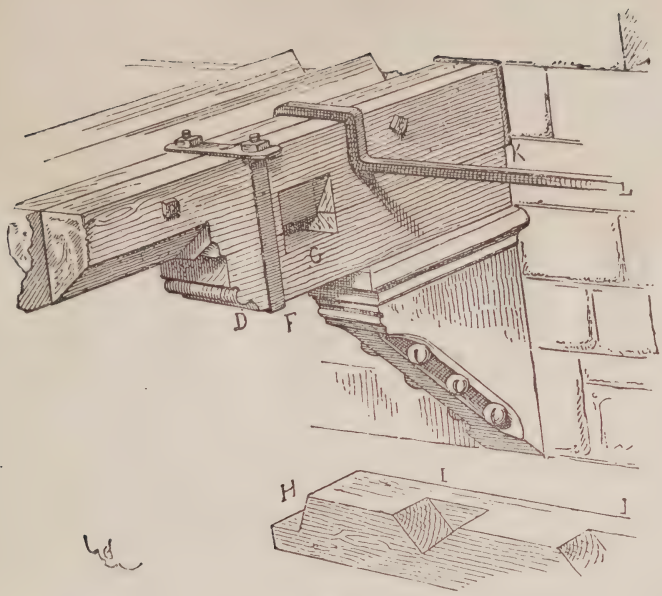


FIG. 33.

FIG. 34.

Fig. 33. — BINDING-JOISTS AND TRIMMERS. — Page 132.

Fig. 34. — PERSPECTIVE VIEW. — Page 132.

CHAPTER XII.

PAUL ADDRESSES CERTAIN OBSERVATIONS TO HIS COUSIN, AND RECEIVES HIS REPLIES.

PAUL, with his head bent over his paper covered with sketchings, his hands on his knees, kept thinking to himself how his cousin had marked over a good deal of paper in making the ceilings, which had always seemed to him the simplest thing in the world. Paul saw little distinction, in his mind, between a sheet of paper spread upon a board, and a ceiling. When his cousin asked him, "Do you quite understand?" Paul, hesitating a little, said, "I think so," and added, after a pause, "but, cousin, why not make the floorings and ceilings as elsewhere?"

"It seems complicated to you, my cousin, and you wish to simplify the task."

"It is not entirely that; but how are they usually made? Are all these means used? I have not seen any of these ashlarings, binding-joists, trimmers, and corbels in any of the ceilings I have known; cannot they, then, be omitted?"

"None of these are omitted in ceilings made with carpen-

try, but they are concealed under a plaster coating; and as I told you, this plaster envelope is one of the causes of the ruin of wooden floorings. In all such are binding-joists and trimmers on the right of the chimney-hearths; there are also sometimes ashlarings: all this is joined together by iron-work to hold it between two plane surfaces having between them the least possible thickness. At Paris, where the houses are very dry, this method is still in use; but in the country it is difficult to avoid the moisture; these sorts of shut-up floorings are in danger of soon falling into decay. You must ventilate the wood, I repeat, to preserve it for any length of time. This anatomy of wooden floorings exists in all which are constructed of these materials, only you do not see it. It is a good thing, in architecture, to make use of the necessities of the construction as a means of decoration, and to frankly admit those necessities. There is nothing to be ashamed of in leaving them to be seen, and it is an evidence of good taste, sense, and tact, to display them, in causing them to contribute to the adornment of the work. To tell the truth, this sort of decoration is the only satisfactory one to people of sense and taste, since there is a motive in it.

"We are accustomed, in France, to judge of everything, above all, of matters of art, with what is called 'sentiment.' It is convenient for a certain number of persons who meet, to talk about matters of art without ever having held

a compass, a pencil, a boaster, or a brush, and the artists themselves have got somewhat tired of reasoning, finding it more simple to agree with these amateurs, who use up pages in saying nothing, and flatter here and there the public taste in misleading it.

"Little by little the architects themselves, who, of all artists, must rely most carefully upon reasoning in their conceptions, became accustomed to neglect all for appearances, and not to attempt to reconcile these with the necessities of the structure. Soon these necessities troubled them, and they hid them so well, that what I will call the skeleton of a building was no longer in harmony with its envelope. There is the structure which is often left to contractors, who get out of it as they can, but naturally attending to their interests, and the form which is applied for good or evil to this structure. Well, with your permission we will not follow this example, and we will make a building, however modest it may be, in which no detail can be found which is not the result, either of a necessity of the structure, or the needs of its occupants. It will cost us no more, and when it is finished we will rest quietly, as we shall have nothing concealed, nothing artificial, nothing useless, and the edifice we shall have built will always permit us to see its organs, and how these organs work."

"How is it, then," said Paul, "that so many architects do not show, as you wish to do here, these necessities of

construction, but hide them, and — why do they do this? What motive have they?"

"It would take a long time to explain that to you."

M. de Gandelau came in at this moment.

"The news is worse and worse," said he. "The German army is spreading everywhere; we must prepare to see the enemy here. Poor France! But what were you saying?"

"Nothing of interest," said the cousin, "compared with our disasters. I was trying to make Paul understand that, in architecture, none of the means of structure should be hidden, and that it is for the interest of the art to make use of them for decorative purposes; in a word, that we must be sincere, reason, and trust only in ourselves."

"Surely," resumed M. de Gandelau, "you put your finger upon our most vital sore. To reason, to trust in one's self alone, to take account of each thing, each fact, by labor and study, to leave nothing to chance, to examine everything, to hide nothing from one's self or others, not to take phrases for facts, not to consider ourselves protected by tradition or custom, — yes, that is what should have been done. It is too late. And who knows if, after the misfortunes which I foresee, our country will recover enough elasticity, patience, and wisdom, to leave sentiment behind, and adhere to reason and serious work? Try to teach Paul to reason, to accustom himself to method; try to give him a love of mental labor; and whether he becomes an architect, an

engineer, a soldier, a manufacturer, or a farmer like myself, you will have rendered him the greatest service. Above all, let him not become a half-scholar, half-artist, or half-worker, writing and talking about everything, and incapable of doing anything for himself. Work! The worse the news which we receive, the more it weighs upon our hearts, the more necessary it is to attach ourselves to a useful and practical labor. Lamentations are of no use. Work!"

"Let us go and visit the work-yard," said the cousin, who saw that Paul was pensive and little disposed to return to his task.

CHAPTER XIII.

THE VISIT TO THE WORK-YARD.

THE building was beginning to take shape, and the plan to appear above the soil. Twenty masons and stone-cutters, four carpenters, and a number of boys gave life to this corner of the estate. Then came carts full of bricks, sand, and lime. Two long saws cut up the trunks of trees into joists; a small movable forge, sheltered behind a copse of trees, was lighted and repaired the tools, until it was ready to forge straps, cramps, feet, stays, and bands. A fine autumn sun spread a warm and slightly veiled light over the work-yard. This spectacle effaced from Paul's mind the sad impressions left by his father's words. Under this aspect the work did not seem to take the severe and harsh forms which had at first somewhat scared our scholar in vacation. An attentive inspector, Paul followed his cousin upon the building site, and listened to his observations with great care.

"Here, Papa Branchu," said the cousin, — "here is a stone which must not be laid down; it has a flaw, and as it is going to serve as a lintel, I do not wish it."

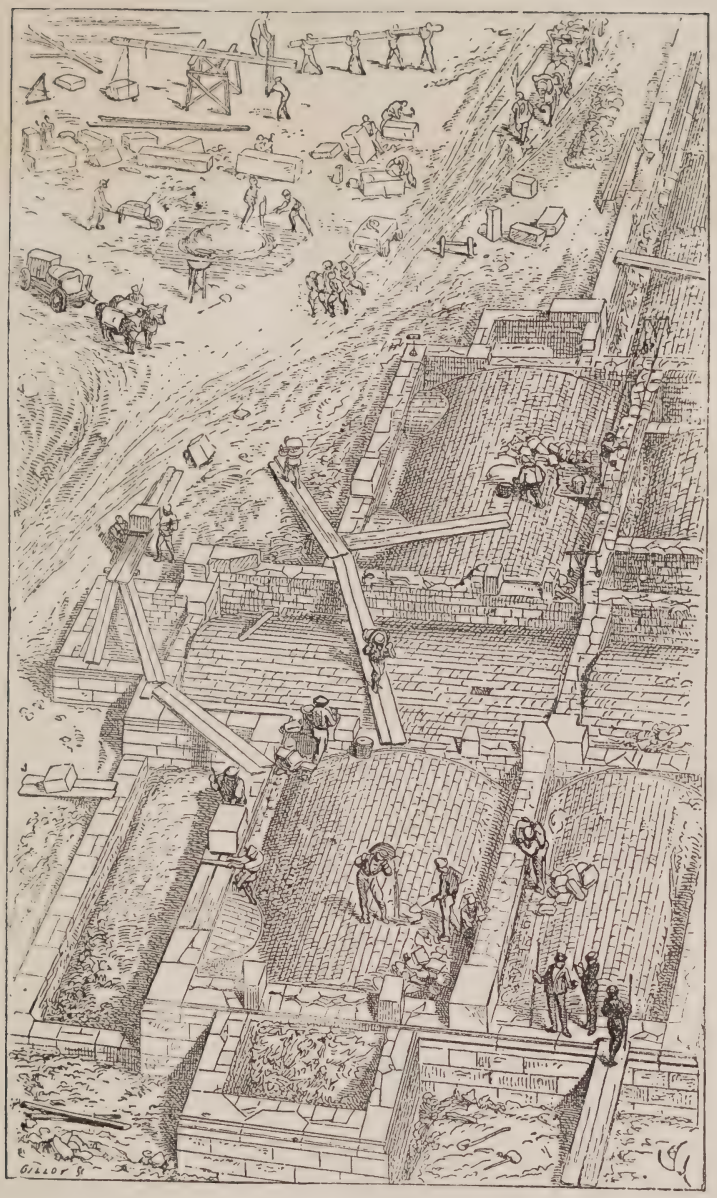


Fig. 35. — THE SITE. — Page 138.

"Eh, Monsieur Architect, the flaw does not extend very far."

"Whether it does or not, I don't wish it. Do you understand? Paul, you will see to it that this stone is not laid. You see this little crack which is hardly apparent; strike the two sides with this hammer. Good! The sound which the stone gives on this side is dead; that shows you that there is a solution of continuity, and that, aided by the frost, this piece on the right will detach itself from the rest. Here are bricks which you must not have used. See how they are cracked; then these white spots, — they are bits of limestone, which the fire has converted into lime. By the action of moisture these bits of lime swell and burst the brick. You will take care, before letting the bricks be used, to have them well moistened. Those which contain parts of lime will fall to pieces, and will not, therefore, be put in the work."

"But, good sir," said Papa Branchu, "it's not my fault; I do not make the bricks."

"No; but it is your duty to send those which are defective back to the lime-burner, and not pay him for them, for it is your business to furnish them; that will teach him to purge his earth of bits of limestone. Here is some sand which contains clay; see how it sticks to the fingers! Papa Branchu, I wish for none but good sand, very rough; you know well enough where there is some. You have had

this taken elsewhere, and it is only good for putting in the haunches of the cellar vaults for filling; be sure and not have it used in the mortar. For mortar, Paul, you must have sand which is very granulated and clean, the grains of which do not stick together; and before using it, several buckets of water should be thrown upon the heaps. Look to it, also, that they do not puddle the mortar on the earth, but on a platform of joists. You have done so; very well; it must not be done otherwise. If you are in a hurry, and your platform is not large enough, make another. Pay attention also, Paul, that the stones are all put in a mortar-bed."

"O, be easy on that score, sir; I do not do otherwise."

"Yes, I know, for basement construction and hard stone it goes all right; but in elevations your workmen usually place the stones on props and plaster them with clear mortar, which is more quickly done. Pay strict attention to this, Paul. All the stones ought to be put in their places, on thick props in the form of a wedge, leaving a vacant space of six or eight centimetres; the mortar should be spread beneath over the whole surface to a thickness of nearly two centimetres; then the four props must be taken away, and the stone, resting on the mortar, must be beaten down with a heavy mass of wood until the joining is only a centimetre thick at all points, and the excess of mortar has overflowed all around.

"Here are some meagre layers, Papa Branchu; they must be re-cut."

"What is a meagre layer?" asked Paul of his cousin, under his breath.

"It is a setting layer, concave."

Taking his memorandaum-book the cousin continued:—

"Here you see that, if the layer of a stone gives the section *A B* (Fig. 36), the middle, *C*, being more hollow than

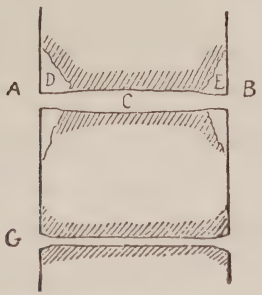


FIG. 36.

the borders, the stone lies on the latter only; hence, if the weight is a tolerably heavy one, the ends *D E* break. It is better that the layers should be made as I trace in *G*, and should not bear upon their edges. So far, Papa Branchu, you have raised your constructions with inclined planes; but we are getting up; scaffoldings will soon be necessary.

"Since we are building with scappled stone, only putting freestone above the basement, at the angles and the frames of the windows and doors, you will leave putlog holes be-

tween these scappled stones. Then you will only have a care for trussels and putlogs. For the mounting, the carpenter will send you a gang of men, and you will use the hoist which I shall have sent you from Châteauroux, which I have no other use for just now."

"If it 's the same to you, Monsieur Architect, I should prefer our machinery."

"What! your devil of a wheel, in which you put two men, like squirrels?"

"Yes, sir."

"As you wish; but I shall nevertheless send for the hoist; you shall try it."

"As a fact," whispered the cousin to Paul, "his 'machinery,' which dates, I verily believe, from the Tower of Babel, raises the weights, when they are not too heavy, much more easily than do our engines; and as we have no very large stones to raise, we will not quarrel with him on this point."

Turning to the master mason, he continued, —

"It is agreed, Papa Branchu, that we do not make any rough-coatings, except for some very delicate mouldings, for chamfers, if there is room; you will place your stones all cut, and there will only be here and there some overplus to take off."

"Agreed, sir; it was my intention."

"So much the better."

Addressing Paul, the cousin continued : —

"I know nothing worse than the custom which prevails in some large cities of rough-coating buildings. Large blocks are laid down ; when all is mounted, these formless masses are cut, pared, clipped, scraped, moulded, and sculptured, most often despite the dressing; without counting that the hard and resisting crust which, especially on soft stone, is formed on its surface when it is freshly cut after leaving the quarry, is thus taken off, — a crust which is never re-formed when the materials have once produced it, and have thrown upon it what is called their 'quarry water.' Happily, in many of our provinces, the excellent habit of cutting each stone in the yard, once for all, according to the definite form it is to preserve, is maintained ; and, once laid, the stone-cutters' tools touch it no more. Besides the advantage of which I have just spoken, this method demands more care and attention on the part of the dressers, and it is not then possible to make the layers or joinings pass at random. Each stone should thus have its function and a form convenient to its place. Then, when a construction is raised, it is finished; there is nothing to go back to. It must be added that this method demands of the architect a complete and finished study of each part of the work, according as he furnishes the orders for the various parts of the structure."

CHAPTER XIV.

PAUL SEES THE NECESSITY OF PERFECTING HIMSELF IN THE ART OF DESIGNING.

ONE thing surprised Paul; the facility with which his cousin expressed, by a few pencil-strokes, whatever he wished to have understood. His sketches in perspective, above all, seemed wonderful; and our embryo architect, when alone, tried to indicate on paper the figures pertaining to his study; but to his great disappointment he only produced a confused series of lines, which he himself could not comprehend a quarter of an hour after he had drawn them. Still he knew that, in making out the calculations which his cousin deemed of such importance, the methods employed by his master would be of great service to him, if he could only succeed in making use of them.

One day, after passing several hours on the ground, trying to take account, by sketches, of the figure of the cut stones, without being able to obtain any satisfactory results, Paul went to his cousin's room.

"I find," said he, "that what I have been taught in linear drawing is not sufficient to enable me to represent in figures,

upon paper, what you have explained to me so rapidly by means of sketches; teach me, then, cousin, how to clearly reproduce what I have before my eyes, or what I desire to explain."

"I like to see you desirous of learning, little cousin; it is half the task done. But it is only the half, and that the least difficult half. I cannot teach you in a week, nor even in six months, the art of easily designing the objects you see, or those which you imagine in your mind; but I will show you the method to follow, and with much labor and time you will reach, if not perfection, at least clearness and precision. To design is not to see a thing, but to observe it. All who are not blind, see; yet how many people are there who *know how* to see, or who reflect as they see? Very few, assuredly, because we are not taught in infancy the habit of this exercise. All animals of a higher order see, as we do, because they have eyes for the most part very like our own; they have even the memory of the eyes, since they recognize the objects or beings they love, fear, or that they make their prey. But I do not think that the animals take note of bodies or surfaces otherwise than by a faculty of instinct, and without the intervention of what we call reason. Many people like us see in the same way; and it is their fault, for they are able to reason. But we are not talking of that. This is the method I propose to you.

"You know what a triangle is, and what a square is; you

have studied elementary geometry, and you seem to know it tolerably well, as I have observed that you have understood the plans, sections, and even the projections of bodies on a vertical or horizontal plane, my sketches having been intelligible to you. Now, you will take some playing-cards, and after tracing, according to any scale you like, the various faces of a stone which you will see cut, upon each of them you will cut these surfaces with a pair of scissors; and by the aid of strips of paper and some paste you will bring them together so as to represent this or that piece of the cut stones. This little model will then be familiar to you; you will know how its surfaces are joined and what angles they form. In the evening you will place these models before you in all sorts of ways, and you will copy them as they present themselves to your eyes, taking care to indicate, by a dotting, the lines of the reunion of the surfaces you do not see. See, here on my table is a wooden rhomboid, which, as you know and observe, is composed of six similar and equal faces, the sides of which are equal, each of the faces giving two equilateral triangles united at the base (Fig. 37). I take, you see, this body between my fingers by its two ends; if I show it to you so that one of the faces is parallel to the plane of vision, the other two faces present themselves obliquely, as in *A*; you see, then, three faces, but there are three others behind, which you do not see. How would they present themselves if the body were transparent,

as the dotted lines indicate? If I turn the rhomboid between my fingers, so that two faces are perpendicular to the plane of vision, thus (as in *B*), I shall see only two faces; two others will be hidden from me, and two following the two lines *a b*, *c d*. Now I present the rhomboid so that neither of its faces are parallel or perpendicular to the plane of vision, thus (as in *C*). Well, I shall still see three faces, but in foreshortening, distorted by the perspective, and the

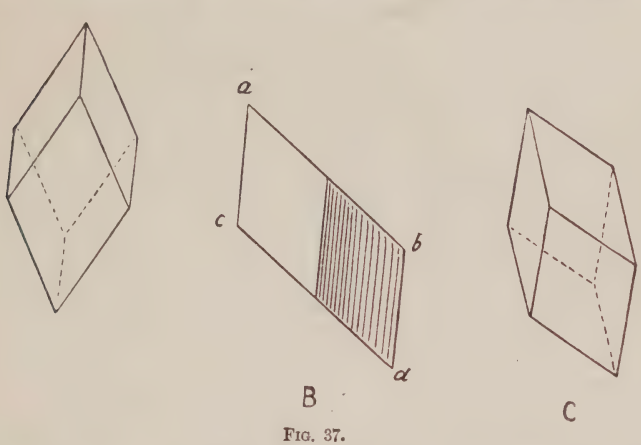


FIG. 37.

other three will be indicated by the dotted lines. Make, then, in the evening, as many little models as you can, reproducing the stones you have seen in the work-yard, and copy these little models in every way. Throw them at hazard on the table, several together, and copy what you see; indicate what is concealed from you by dotted lines. When you have done this for a week, many difficulties will have already become familiar to you. After that, we will see."

This method delighted Paul, and he at once went to work, by aid of some of his abstracts, to make a little model of one of the stones the faces of which he had measured. It was the "summer" of an arch with square facing. He obtained with some difficulty a very fair little card model which he proudly placed on the family table after dinner, first copying it on the lower surface, and then placing it in different ways (Fig. 38). He would have continued at his

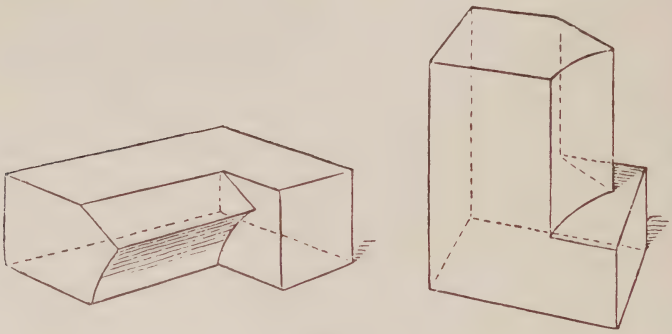


Fig. 38.

task all night, so wrapt up was he in it, had not Madame de Gandelau admonished him to retire, at eleven o'clock. Paul found it hard to get to sleep, and his dreams were full of complicated card models, which he tried in vain to bring together. He rose late next morning, and, going into his cousin's room, told him of the uneasy night he had passed, as an excuse for his tardiness.

"Good!" said the cousin; "you have the fever of descriptive geometry, — so much the better; it is only well learned

when one has a passion for it. We will work at it together when the cold snaps suspend our constructions, and bad weather shuts us in-doors. An architect must learn to make use of descriptive geometry, as one writes orthography, without stopping to ponder over it. Perspective must be absolutely familiar to him. You cannot learn one or the other too soon, and it is only in early youth that these things can be so acquired that it will not be needful to think of them, should you live a century. You are a good swimmer, and if you fall into the water, it is needless to tell you by what movements you may keep on the surface and guide yourself. Well, it is in this way that you must know geometry and perspective. Only you must give more time to the practice of this essential branch of our art, than to learning to swim like a frog."

CHAPTER XV.

THE STUDY OF THE STAIRCASES.

IT was time to consider the details necessary to the execution of the staircases. The cousin had told Paul to prepare them; but Paul, as might be supposed, had only furnished a number of confused sketches, as unintelligible to others as to himself, despite the hints afforded him by the master architect.

"Come," said the cousin, "let us work at this together. Papa Branchu and the carpenter ask for instructions. Let us first take the great staircase, and mark out its cage, or envelope. We have, as the height of the ground-floor, comprising the thickness of the flooring, 4 m. 50 c.; the steps should only be 15 c. in height each; we must therefore have thirty steps to reach the level of the first floor from that of the ground-floor. Each step should be from 25 c. to 30 c. in width, to give an easy ascent. Thirty steps, then, give 7 m. 50 c. or 9 m. of development. I believe I told you this when we made the plan of the ground-floor. If we take the middle of the space reserved for the steps, on our plan, we find just 9 m. Tracing the steps, then, on this

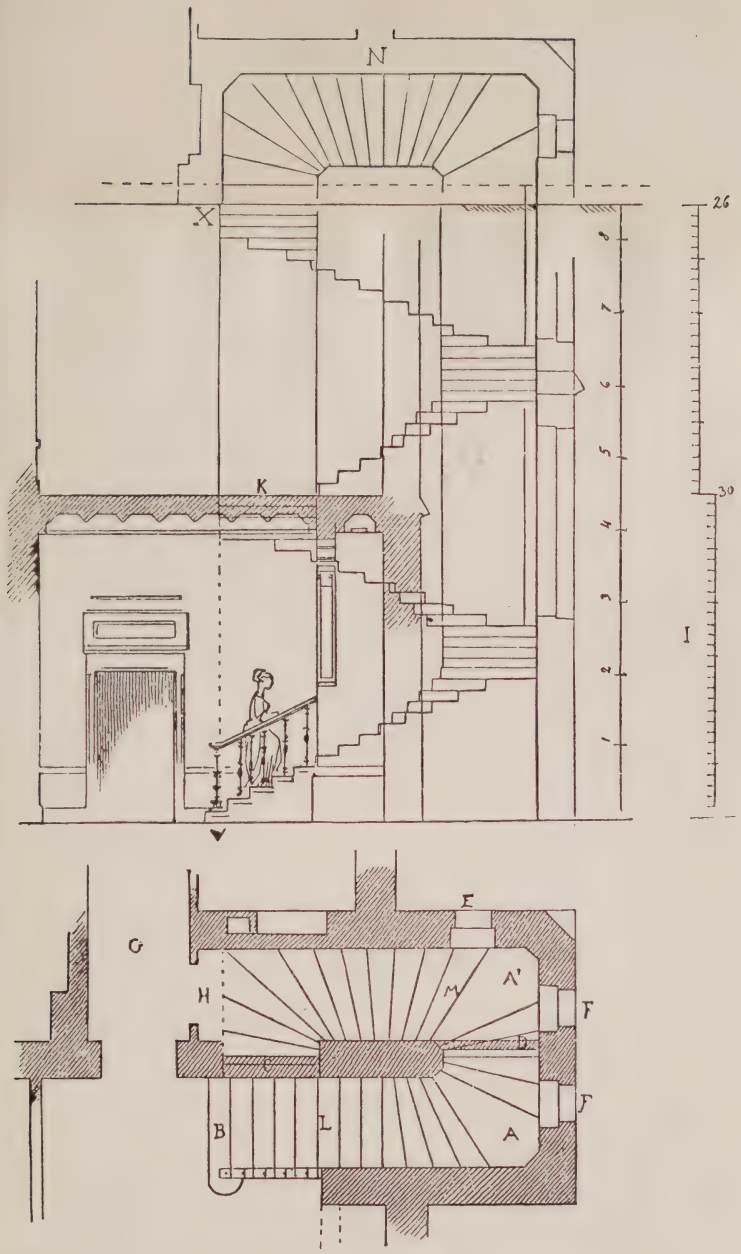


Fig. 39. — OUTLINE OF THE MAIN STAIRCASE. — Page 150.

middle line, and giving them 275 millimetres of stepping space, we may find two landing-places in the angles at *A*, *A'* (Fig. 39); we will make the steps wind in such a way as to avoid sharp angles near the newel. The first step will be at *B*, the last at *C*. At *D* we will make, under the step-grooves, the partition which will enable us to establish the water-closet at *A'*. As, at this landing-place *A'*, we have ascended 18 steps (each 15 c. in height), we shall have for the water-closet 2 m. 50 c. under the ceiling, which is more than sufficient. We will light it by a window *E*. The two openings *F* will light the staircase, and, as the elevation indicates, will follow the level of the steps. For there is nothing more ridiculous and inconvenient than to cut off the windows by the steps of a staircase, and though this is done every day in dwelling-houses, it is a folly which every builder ought to avoid. From the servants' corridor *G*, the water-closet is reached by the door *H*.

"Let us now trace the elevation, or rather vertical projection, of this staircase. This is how to proceed: the cage is traced in elevation; then the height of the ascent is divided into as many parts as there are to be steps, as I do in *I*. Projecting these divisions horizontally on the elevation, and, vertically, the ends of the steps with the cage and the newel, you obtain, by the meeting of these two projections, the tracing of the steps along the cage and against the newel.

"Suppose that to be done. The last step is then at *K*, at the level of the flooring of the first floor. To ascend to the second floor, we have 4 m. to ascend from one flooring to the other; giving 0.156 m. to each step, we get 26 steps plus the fraction of a millimetre, which it is not worth while to count. Then we will preserve, on the plan, the tracing of the first revolution, leaving the step *d*, which gives 13 steps to the point *M*. From this point we will trace the 13 other steps to make the number 26, as I mark on the end of the supplementary plan at *N*. Then, for the elevation, we will proceed as before. We shall thus obtain the general tracing from *V* to *X* for the two floors. This established, we must know with what material these steps shall be made. As they are comprised between walls and a newel, which is itself a wall, we can, if we wish, make them of freestone, of a single piece each. However, this is scarcely practicable here, because it is hard for us to procure any hard, compact, fine stone proper for the purpose. We will therefore content ourselves with making the first step only of stone, and the others in carpentry-work, covering them with good oaken shelves; and, in order not to fix them in the walls, we will have a projecting string-course in masonry, forming a rack along the walls and the newel, to receive the part of their butt-ends, as I show you (Fig. 40). These steps, left rough underneath, will be lathed, and will be planed only on the face, or vertical side, *A*. That they

may not be shaken from their support of masonry, we will fasten them with cramps *B*, which will be masked by the shelf forming the step, and will enter the holes *C*.

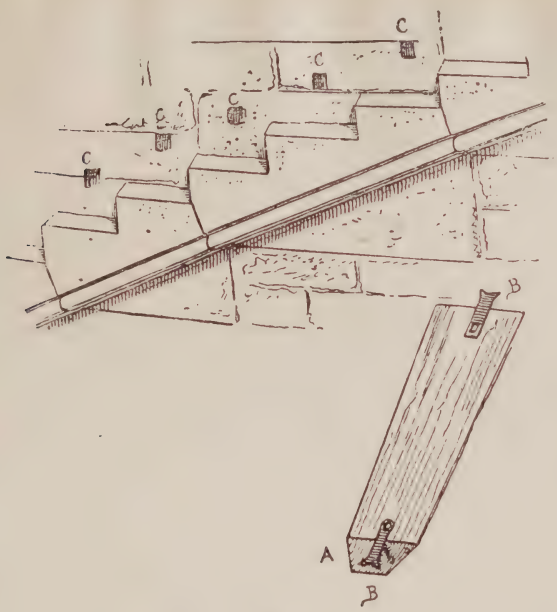


Fig. 40.

"As for the servants' spiral staircase, we will make it of hard stone, each step carrying the newel, as I show you in Fig. 41.

"Now try to write this out clearly, so that we may promptly give the details to the masons and the carpenter."

Paul succeeded, with some difficulty, in making a tolerably accurate tracing according to the indications furnished by his cousin; but the latter was obliged to frequently make

corrections, for his inspector was not too skilful in elementary descriptive geometry, and the projections gave him difficulty at every step. Paul got confused in his lines, took

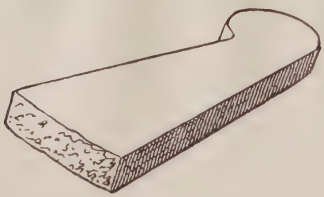


FIG. 41.

one point for another, and would have more than once thrown aside his compass, square, and ruler, had his cousin not been there to set him on the right path again.

CHAPTER XVI.

CRITICISM.

IT was towards the end of November; but the weather had, so far, permitted our builders to make the most of their time. The autumn sun favored their project, and the house had already risen, at several points, to the height of the lintels of the ground-floor windows. Still, it required all M. de Gandelau's energy to prevent the works from being abandoned. The little work-yard was gradually deserted by able workmen, called to follow the flag. Those who remained lost time and let their thoughts wander elsewhere. There could be little carting, for all the horses and carts came under military requisition. The country was furrowed by troops taking their way towards the Loire. Many hours were passed in talking, and every one anxiously awaited news of the war. It became every day more gloomy. Still, Orleans had been reoccupied by the French troops, and all hope did not seem yet lost. Paris still held out. Meanwhile, a new personage arrived at M. de Gandelau's château; a friend of the family, whose property had been occupied and devastated by the Germans, and who had abandoned it, fearful

of still worse calamities. He had directed his steps towards Western France, where he had relatives, and on his way stopped at M. de Gandelau's. He was a man between fifty and sixty, tall, with a rather cold manner, though a perpetual smile seemed stereotyped on his face. He might have been taken for an old-fashioned diplomatist.

The new-comer had read and travelled much, knew a little of everything, belonged to several learned societies, and his opinion was greatly respected in his own neighborhood. He had been a candidate for the Assembly, had engaged in industrial enterprises, in which he had lost large sums, then in agriculture; and the remainder of his fortune being in peril of becoming ingulfed, he contented himself with the theoretical aspect of affairs, and wrote pamphlets on all sorts of subjects, which he printed at his own expense, and scattered broadcast. Each of his works pretended invariably to give a simple solution to all difficulties, whether in politics, science, industry, commerce, or even the arts. He had built houses, and as it seemed to him that architects were quite unfit to practise the art of construction, being expensive and imbued with prejudices, he had himself taken charge of the building operations; making his own contracts, treating directly with suppliers, giving the plans, and supervising the works. This fancy had cost him very dear, and one fine day his building fell down. Engineers not enjoying his confidence any more than architects, he had traced out roads on his estates, and

had them executed according to a system of his own. His attempts in this direction were not more successful than his essays at construction. The roads persisted in being impracticable. But M. Durosay (that was his name) was one of those persons whom experience teaches little, even when the lesson is at their expense. For the rest, he was an honest man, excessively polite, obliging, even generous; above all to those who had the artfulness to flatter his eccentricities, and who, by interest or conviction, regarded him as an infallible judge on every subject.

If any one came to him to consult on any matter just as he was about to take a train, he would rather let the train go than not to give his decision on it at length. Only he judged of everything on an *a priori* system, and heard with inattentive ear the special reasons which might tend to modify it. But he admitted discussion freely, and was not in the least impatient with those who did not agree with him. He often repeated this aphorism: "Light bursts from the collision of contrary ideas"; but he always meant to furnish it himself, and never to receive it.

When he had been duly installed in the château for some hours, and the sad topics of conversation which were the order of the day had been exhausted, and when the talk turned on Paul's house (as it was called in the family), M. Durosay asked to see the plans.

"I know something of building," said he; "I know what it is."

The cousin smiled, which the new-comer did not resent, his misadventures in building having left no bitterness in his mind.

"Ah, this is very well!" said M. Durosay, when the plans had been explained to him and he had examined them; "I have seen houses in Belgium something like this. There are good ideas in it; it would be a very agreeable habitation, if Messieurs the Prussians are so good as to allow you to finish it. Will you permit me a few remarks?"

"Certainly."

"I have n't the least idea of persuading you to change anything in these plans, which seem to me to be excellent; but I have seen and compared a great deal. Well, to tell you frankly my first impression, it seems to me that this has rather the character of a city mansion than of a country-house. You will excuse me, will you not? I don't understand why a country-house should be so shut up; I should like to see a portico around it, or at least a large veranda; windows more open, the expression more perceptive of the exterior life."

"Eh, my dear friend!" said M. de Gandelau; "I hope my children will pass here a large part of the year; we are not planning a place where they would only live two or three months in the summer, after getting tired of the city; they must have a good, tight, well-covered house, where they can reside in all seasons."

"Yes, certainly, that is wisely considered; but what do you think of the villas in Northern Italy, where the climate is bleak in winter and spring, and which are not the less delightful with their porticos, terraces, their large open halls, and their bay-windows looking out upon the country? All these have a noble aspect, elevate life, one might say, and enlarge narrow ideas, which are but too prevalent in our times. Then, don't you think that the want of symmetry is too glaring, at least on one of the fronts? This resembles, somewhat, constructions made one after another, so as to satisfy successive needs; and is it not wanting in that unity which should be found in every work of art?"

"But I do not propose to leave a work of art to my daughter; only a good, solid, convenient house."

"Perhaps so. You will agree, however, that it is well if both qualities can be combined. For a cultivated and charming person like your daughter, it is not unseemly that her house should reflect that cultivation and charm on the outside. You would not be displeased, on going to see Madame Marie, to see the little family which is in prospect grouped around her under a portico or loggia of delicate architecture. This seems to me to be rather the house of some grave Flemish alderman. These gables have a certain austere aspect which —"

"Come, my friend, gables are not austere; they are gables, that's all."

"O, these gables with their big roofs have a severity of look which is not in harmony with the idea of a pleasure-house!"

"But it is not a pleasure-house; it is a house built for people who are to inhabit it; not for saunterers, as we see none here."

"Never mind; I should have liked to warm up these exteriors, which are slightly cold of aspect, by projections, bay-windows, and a gallery covered by a terrace overhead."

"Warm up,—that's soon said; but one catches rheumatism under your galleries. It 's well enough for Nice or Mentone, but they are scarcely practicable in this part of the country. It is best to have the sun strike the walls of our houses, and your porticos are hot-houses for mushrooms."

"I see," said M. Durosay, after a pause, "that you adhere to your taste, my friend, for what you call the practical side of things. Yet, what a good chance this is to give your daughter one of those mansions which, without neglecting the material comforts of life, possess that perfume of art which is too seldom found in our country districts. A little exterior elegance is a powerful charm, which leaves an indelible impression on the mind. It is thus that the Italians preserve the poetry of the brilliant eras of their civilization. They know how at need to sacrifice a part of what we call 'comfort,' of the necessities of the material life, in order to preserve among them these beautiful traditions of high art."

"I don't know what are the traditions of high art, nor if these traditions protect us from wind, rain, and sun; but I confess to you that your Italian villas, in the neighborhood of Verona and Venice, always seemed to me very gloomy and disagreeable, with their colonnades and closed shutters. I was never anxious to visit them, for I supposed them far from comfortable. If they are made to display models of architecture to travellers, I am quite willing; but I am not anxious to amuse or interest travellers, and my daughter partakes of my own feelings in this respect."

"Perhaps; yet your daughter is now visiting Italy, and will tarry on the borders of the Bosphorus. Who knows whether, on returning hither, she would not be delighted to find, as it were, a *souvenir* of the impressions she will not fail to have received there, and whether the surprise you are arranging for her would not be the more welcome, if you recalled some of these impressions to her mind? What do you think of it, Monsieur Architect?"

"I am listening to you," said the cousin, "with delight to hear you talk so well about our art."

"So you would share my opinion, and would be disposed to give this dwelling, so well distributed by your skill, a few exterior embellishments in which it is, perhaps, now wanting?"

"I do not say that. M. de Gandelau has, as his custom is, given us full liberty, and has only furnished me with the

figure of the sum to which he wishes to limit the expense. Otherwise, the plan being accepted, he has neither imposed upon us an excessive severity, nor forbidden us to use what you regard as the exterior adornment of a house."

"Well, if my friend, with his positive mind, does not appear inclined to these adornments, don't you think, as an artist, that something might be added to these fronts, which are perhaps a trifle severe in aspect, and which surely, by aid of your talent, you might make less cold? You know Italy; you have visited Pompeii; don't you find, in the architecture of that country, a thousand inspiring hints, ravishing examples, and — "

"Yes, I have visited Italy and France, and I confess to you that I have never been attracted by their architectural works, except in so far as they preserve the imprint of the manners and usages of those who have produced them. You speak of Pompeii. What has especially struck me in the remains of that Italian provincial town is exactly this quality. Those small habitations were very convenient to the customs of antiquity, at the time when they were built, and in the climate in which they were erected. But I deduce from this study, that as we are not on the shores of the Bay of Naples, and have habits very different from those of the Pompeians, our dwellings should in nothing resemble theirs; that if, for instance, it was very agreeable to sup in an open 'triclinium,' sheltered from the wind by a 'velum,'

we could not arrange dining-rooms in the same way in the Department of the Indre; that if it was very pleasant to sleep in a chamber with a surface of four or five metres, the door of which was left open on a court surrounded by a portico, this would be very inconvenient for us, and we should run a great risk of catching cold if the door were left open, and of stifling if it were shut. But since you speak of ancient dwellings, permit me to observe that those of Pompeii, even the most elegant of them, do not display on the outside any of the adornments which you seem to like. The ancients kept the luxury they enjoyed for the interior, nor did they care to make a display to passers-by. I do not know so much about their villas, or country-houses; but I have every reason to believe, from the ruins still extant, that they did not make sacrifices to what is the entirely modern vanity of showing, on the outside, forms of architecture to make an impression on wayfarers. I think that the country palaces which seem to have seduced you in Northern Italy are much more works of vanity, than dwellings proper to the customs and habits of those who erected them; indeed, they have been scarcely habitable, and the state of dilapidation in which you see them is by no means recent. Erected for vanity's sake, for the desire of display, they only endured, as residences, as works due to vanity endure, that is, a few years of the life of a man; after which they were abandoned"

"You give the name of vanity," replied M. Durosay, "to what I regard as the love of the art; the desire to show the work of art."

"We should probably never agree upon this point. I believe that art consists, in architecture at least, in being true and simple. You only see a form which pleases or displeases you; I seek something else, or, rather, I first observe if this form is the expression of a want, if it has a reason of existence, and it only pleases me when this condition, according to my judgment, is fulfilled."

"So a barn is, to you, a work of art?"

"Certainly; if it is well made for protecting its contents, it is in my eyes worth much more so than an uncomfortable palace, though it be decorated with colonnades and pediments."

"You ought to go to America."

"Perhaps I should do wisely, if I knew that they tried to build there in accordance with the tastes and needs of the inhabitants. But in America, as everywhere nowadays, pretensions are made to 'style,' and things considered fine are eagerly copied; that is, traditions are applied at random, the origin or principle of which is not sought."

"Come," said M. de Gandelau, who thought the discussion getting long, "we are getting far away from Paul's house: in order to satisfy you, when you come to see my daughter in her new residence, we will build a card portico

before one of the fronts, and place under its shadow a number of Berri peasants disguised as Venetians, mingled with some lords in scarlet robes, playing on the viol and the bassoon. It is late, and time to go to bed."

CHAPTER XVII.

PAUL ASKS WHAT ARCHITECTURE IS.

THE cousin foresaw that Paul would revert to the discussion of the evening before; and as the two wended their way, early in the morning, to visit the works, Paul did not fail to feel his way towards it. But he did not quite know what he wished to ask. The cousin did not assist him, but left him at full leisure to collect his thoughts.

"Does M. Durosay know much about architecture?" Paul finally asked.

"Why, he speaks like a person who is not a stranger to the art."

"Still, you did not seem to grant what he asked."

"And what did he ask?"

"Why — you know — he wanted Marie's house to be — more — "

"More what?"

"More — less severe. He suggested a portico, a loggia. What is a loggia?"

"It is a large covered balcony, usually shut in on two

sides, but opening in front, on the ground-floor or upper floors, upon the public road or the country."

"Why should we not have a loggia on Marie's house?"

"You might, one or several."

"Well?"

"Then we must put it, if on the ground-floor, in front of the drawing-room, in the middle of the fronting on the garden; if on the first floor, before the large bedchamber."

"Would not that make a good effect?"

"Perhaps; but the apartment opening upon this loggia would be dark and gloomy, as the windows would fall under its ceiling."

"O, yes, that 's true! but we have bay-windows at the end of the drawing, dining, and billiard rooms."

"Yes; only these are shut instead of open towards the outside, and these rooms have the benefit of their additional space. They are, then, cages, what were formerly called 'brèteches.' You have thus the advantages of a loggia, without what, in our climate, would be its inconveniences."

"Why did you not say this to M. Durosay?"

"He knew it well enough; there was no need to tell him."

"He also suggested a portico."

"For what?"

"I don't know. He said it would look well, and that my sister and her children would be grouped under it, which would look prettily from a distance."

"And would your sister like to look picturesquely from a distance?"

"O, I don't think she would care much about it!"

"And for whom are we building the house?"

"Why, for my sister."

"And not for loafers, eh? This portico would be as inconvenient as the loggia, for it would make the rooms which opened on its colonnades dark and gloomy. As we usually live in the rooms which would be under the portico, it would cost rather dear to make pleasant groups on it for passers-by."

"No doubt. Besides, we have a greenhouse with a descent to the garden, before the billiard-room, which can serve as a portico, and will not make the room gloomy, as it is of glass."

"Assuredly."

"M. Durosay, perhaps, did not take note of it."

"Likely enough; it is not 'monumental.' He wanted a real covered portico, like those of Italy."

"He seems to admire Italian architecture very much."

"Which?"

"That of which he spoke."

"But there are many sorts of Italian architecture, according to epochs, latitudes, and the habits of the people."

"You did not call his attention to this."

"He ought to know it."

"I see that you do not take M. Durosay's opinions in earnest."

"M. Durosay is an estimable man; his opinions are sincere, and therefore I take them seriously; but he looks at things from a point of view different from mine. He judges matters of art like a man of the world, and I think that we architects should judge them by reasoning. Sentiment does not reason; it is like faith; therefore we could not come to an understanding, since each of us spoke in a different tongue."

Light did not break upon Paul's mind. Till then he had thought that architecture was learned much as one learns grammar and orthography, and now his cousin told him that there were several languages of it, and that if a person knew one of them, the others still remained incomprehensible. He did not understand why reasoning should enter into a matter entirely of form and appearance; and he did not know how to ask questions on the subject which might enlighten him. He walked with his head down, beating with his cane the yellow thistles which sprinkled the roadside. The cousin did not seem anxious to break the silence, and thus they reached the work-yard. It was nearly deserted.

"There was a frost last night," said Papa Branchu, "and it is going to freeze."

"Well, the masonry-work must be covered with rubbish and stubble, and we will stop. Put portlasts on the walls,

stubble above, and slabs at intervals. Have a care that the portlasts cover the facing of the walls. If you have n't enough stubble, put earth on the portlasts, or clods of turf. For the cellar vaults, spread them over with a good bed of earth, with slopes, and fix some openings in the haunches, so the rain or melted snow can run off. Come, do this up quickly, so it may be finished by to-morrow night; then we will lie by till the cold weather is gone."

"All the boys are off," said Papa Branchu, "and there are only a few worthless fellows at the work-yard."

"This suspension of the work," said the cousin, on returning towards the château, "will enable us to study the details of construction at leisure."

"Yes," said Paul; "but I would like to know how you set to work to trace a detail."

"You have seen it done during the two months we have been at work?"

"Not entirely; I see that you say what you wish, and that what you wish is speedily traced on paper; I have tried to do it myself, and though I knew well enough what I wanted to do, nothing appeared on the paper; what I drew on the paper, too, made me forget what I had in my mind. But there must be a means of doing everything one wishes to do in architecture; a method, a — what shall I say? — a receipt —"

"Ah, there you are! You see, little cousin; you think you understand and wish a thing, without really knowing

always what you wish, or comprehending a proposition clearly; since morning your thoughts have been turning about the question you have only just now put to me; I wanted you to take time to make it precise; it was necessary that your brain should tug at it. Now, thanks to the effort you have made, you will the better seize my reply. You recall Boileau's verse: —

> 'What is well conceived is clearly announced,
> And the words to say it come easily.'

These words may be applied to all the arts. The important thing is to become accustomed to acquire clear conceptions; the trouble is that people learn to make phrases before learning to reason, and wish to express their thoughts before they have been elaborately wrought out in the brain.

"Then people think they supply what they think is incomplete in the thought, by a happy combination of words; in architecture, they dwell upon what seems attractive, before knowing whether it answers what reason, a rigorous regard for the necessities or needs of a construction, demand. If an address is in question, vulgar minds are easily led by brilliant phrases, and only too late perceive how much hollowness this seductive form conceals. If architecture is the subject, vulgar minds are in the same way seduced by picturesque aspects and attractive forms, and afterwards learn the defects of the edifice at their own expense. M. Durosay, impressed by certain forms which have pleased him in his travels, has

never thought to ask himself if these were in harmony with the necessities which are to be satisfied, the needs of the structure; he has only seen the turn of the phrase, and has not sought to look for a ripe idea behind it. We might therefore argue thus for days without convincing each other, he sticking to the form only, or the fashion in which the phrase is turned, but not ascertaining whether this form has a signification, and whether the phrase expresses a clear thought. All is in that, my cousin; and, according to my idea, our country, so near utter ruin, will not rise again until she learns to reflect before speaking. We build great edifices which cost fabulous sums, and we are not clear as to what they are intended to contain. Or rather, we think of making the box, without destining it to this or that use. And observe well that this wretched habit does not appertain to monumental structures only. How is it that worthy citizens like M. Durosay, if they have to build a house, think first of erecting a chalet, or an Italian villa, or an English cottage, without scarcely knowing whether they will live comfortably in it? Thus you will see Italian villas in the North of France and Swiss chalets at Nice. Learn to reason, to observe first, and you will be a good lawyer, doctor, soldier, architect. If nature has endowed you with genius, so much the better; it will be a splendid complement to your faculties; but if you have not learned the habit of reasoning, genius will serve you nothing, or rather it will not be developed. To learn to reason,

you must work much and long, and not let yourself be seduced by appearances, however attractive. Unhappily our system of education in France leads us to be content with appearances, to rely on traditions regarded as articles of faith, and not, therefore, to be disputed. You will find confronting you everywhere M. Durosay's portico. The army, the administration, literature, politics, the arts, have their 'porticos,' which you must accept, to do it matters not what, or to enter it matters not where; at least, unless you have enough energy, power of working, independence of character, knowledge of business, tenacity, and therefore authority, to say, 'I will only accept your portico in so far as I find it useful to serve my purposes.' To return to your question, Are there, in architecture, receipts, methods of procedure? I answer that there are practical methods proper to construction; but as the materials and means of execution are every day modified, the methods ought to follow these variations. As for architecture, there is a method to follow in all cases which present themselves, but no receipts or procedures. This method is none other than the application of your reasoning power to each special case; for what is good in one case is not in another. It is then on the observation of these circumstances, facts, habits, climate, conditions of hygiene, that your reasoning will rest before conceiving the work. And when this operation is completed, and arranged in your brain, you may without hesitation put the result of this intellectual labor on paper."

"I think I understand what you say; but how shall I begin?"

"By getting the habit of observing everything, and reflecting upon all you see, hear, and read. When you have before you a ditch which you must cross, do you not ask yourself, within, whether your legs will enable you to jump to the other side? Do you not know, by previous observation, whether or not you can cross this ditch, and do you not decide upon one or the other course? The result of these observations, then, establishes in you a conviction which enables you to act without hesitation. You do not ask yourself, before jumping, whether Achilles or Roland, according to the poets, jumped over much larger intervals. It is you, it is your powers, that you consult, not those of heroes,— unless you wish to fall into the water. Well, if you have a house to build for some one whom you know, you say to yourself at first that a house is made to shelter people; then you represent to yourself the number of rooms that are necessary, and what relations they should have with each other, and the habits of the occupant. You know whether he lives alone, or receives many guests, in what seasons he will occupy the house, whether he likes his ease or lives very modestly, whether he has many servants, or is served by one, etc.; and when you have reflected on all these essential conditions, you try to put the result of your observations on paper. But if you occupy yourself first with placing this

man and his family in a Pompeian house, or a manor-house of the Middle Ages, the chances are that you will erect for him an uncomfortable dwelling, where you will be forced to make awkward dispositions in order to raise a construction belonging to an epoch and civilization different from those in which we live."

"I understand that; yet one learns how to make a door, a window, a staircase."

"That is, we are told how, before us, other men went to work to make a door, a staircase, a flooring; but it is not and should not be pretended, in teaching you the methods employed by our ancestors, to impose on you the task of doing exactly as they did, since you, perhaps, possess materials that they did not have, and your habits are different from theirs. It is, or ought to be, said to you: 'Here are the results of experience acquired from antiquity down to our own time; start from here, do as your predecessors have done, apply your reasoning faculties to making use of acquired knowledge, but only obeying it when it fulfils the needs of the present. It is not permitted to you to ignore what has been done before your time; it is a common storehouse, a good acquired; you must know its extent and value; but add to it the aid of your intelligence; do not go backward.' Well, there is but one method of not going backward in architecture; it is to make the art the faithful expression of the necessities of the times as one sees them, that the

edifice may be in truth the envelope of that which it contains."

"Do they not do this?"

"Not exactly: we are somewhat like those people who have inherited rich furniture from their ancestors, very respectable and respected, who keep and use it, though it is very uncomfortable, and does not correspond to the habits of the time; who even set some one to guard these antiquities, with the order not to let them be in any way changed. If you, then, the master of the house, wish to change the material, or send some of this furniture, more annoying than useful, to the garret, the guardian whom you pay and lodge puts on a dignified air, and declares that the duties with which you have invested him, and which he proposes to fulfil correctly, prevent his permitting these changes and suppressions; that it is confided to his honor not to let this furniture become dilapidated or changed, since he is placed there to preserve it. You continue, for the sake of peace, to use this inconvenient furniture, and you retain its guardian."

"I do not entirely understand you."

"You will, later on; only regard yourself as warned. If you enter some old hotel, full of furniture out of use, beware of criticising it; if the masters of the house are content with him, the guardian of these curiosities will do so well, that you could not re-enter there."

CHAPTER XVIII.

THEORETICAL STUDIES.

THE cold weather made it necessary to suspend the works. It promised to be a long winter. The cousin and Paul prepared to employ this enforced leisure in a profitable manner. They decided that not only all the details necessary to the completion of the works should be elaborated, but that the cousin should profit by the winter season to give Paul some instructions which he needed as inspector of works.

Paul grew every day more interested in this task. Up to this time the execution had followed the study within doors, and example and practice had illustrated the theory; but he clearly perceived that all his attention and desire to second the master of the work did not suffice, and that at each step he was confronted by a difficulty. The more the work advanced the more powerless he seemed to himself. He set to work, then, with a hearty ambition to learn, inasmuch as everything around assumed a more gloomy and desolate aspect. Paul had never lived in the country in winter: when he went home for the New Year's festival, the few

days passed there flew by so quickly that he had no leisure to pay attention to the aspect of the fields. Besides, the family had visitors at that season; his eldest sister was at home; everybody was disposed for a good time. This was not the case in early December, 1870; the neighboring villages were deserted, or occupied for a few hours by ill-clad troops, dying of hunger, going to fight, too often without enthusiasm, leaving stragglers and the sick in the hamlets. Then there were long lines of wagons, which seemed so many funeral trains.

The snow began to cover the fields and deaden the far-off sounds. It was seldom that a peasant presented himself at the château: the postman still came regularly, and the letters and papers which he brought only still more saddened the faces of the inmates. Sometimes soldiers were lodged at the château; all were mute; the officers themselves asked to retire to their chambers, saying they were fatigued, and did not make their appearance in the drawing-room. M. de Gandelau, who, despite his gout, rose very early, seemed to multiply himself; he appeared among the farmers at the neighboring village, hurrying the transports, organizing hospitals, collecting food, and getting over the difficulties imposed by routine.

"Make Paul work," said he to the cousin, every evening; "that is all I ask of your friendship, — and it is much; make him work, I pray you."

The days passed for the most part in studying certain branches of construction; then the architect and his inspector took a walk before nightfall, during which the cousin did not fail to lead the conversation to some interesting topic. The country, natural phenomena, were habitual subjects of his talk; and thus Paul learned to observe and reflect, and he daily perceived how much knowledge it was necessary to gather to do a little thing. The cousin often repeated to him, —

"The more you know, the more you will recognize how little you know; and the limit of science is to acquire the conviction that you know nothing."

"Then," said Paul one day, "of what use is it to learn anything?"

"To be modest; to fill life with something besides the preoccupations of vanity; to make yourself a little useful to others without demanding their gratitude."

The cousin made Paul draw a great deal, always after nature, or after copies prepared in presence of his scholar, for he had not brought any architectural designs with him. Paul copied out the calculations of those parts of the construction which were already elevated. Thus he took exact account of the structure, of each piece of stone put into the work.

Paul began, then, to trace properly an architectural detail, and his cousin never failed to answer each question ad-

dressed to him. Paul had soon got over all timidity, or, if you please, self-esteem, and he no longer shrank from showing the little he knew and multiplying his questions. The cousin had a way of waiting till his young inspector asked to be enlightened, before giving him a lesson on any particular subject; he wished that his scholar's intelligence should be prepared by the necessity of knowing, before instructing him. The lessons thus treated of a great variety of subjects, but the cousin was careful to connect them all, by pointing out the general principles which constantly made their appearance.

One day, Paul wanted to know what an "order" was, and what this word meant in architecture.

"Your question is a large one, little cousin, and I am not sure I can answer it so as to give you light upon it. There are two meanings to this word in architecture; 'order' signifies, sometimes, the correlation between the parts. But I think that is not what you mean; you probably ask in what consist what are vulgarly called the orders of architecture. The idea of order in your mind implies a series of columns, or vertical supports, carrying an entablature, or horizontal bar. That is it, is it not?"

"Yes, that is it."

"Well, in former times architects naturally had the idea of erecting vertical points of support, and of placing from one to the other, on their tops, traversing pieces of wood or stone; and upon this they established a roof. This formed a shelter,

open below, — what we call a hall. But as in many cases it was also necessary to shut these covered spaces, walls were built behind these vertical points of support, leaving between them and the isolated supports a free space called a 'portico.' In this way, for instance, were built certain Grecian temples. Little by little the genius of the architects, study, the observation of the exterior effect, caused relative, delicate, and harmonious proportions to be given to these vertical points of support and that which they supported, namely, the entablature, whence laws were deduced; for, remark well, the example always precedes the rule, and the rule is only the result of experience. The Greeks thus formed three orders, — the Ionian, the Doric, and the Corinthian, — each of which possessed its harmonious system of proportions and its ornamentation. These systems are not so absolute among the Greeks but that they often encroach upon one another.

"But the Romans, who were people of 'order,' and pretended to impose it everywhere and in everything, in taking these systems from the Greeks, wished to reduce them to a nearly absolute formula. This simplified matters, and the Romans liked to shut up matters of art in an administrative limit. When antiquity was studied in the sixteenth century, they did worse; for they assumed to fix forever the relations between the various members of each of these orders, and to leave a certain degree of latitude to the architects. Two others were added to the three first orders, — the Tuscan and Com-

posite. These mummified orders have been applied no matter where or how, as a piece of tapestry is hung to a wall to decorate it. Architects have often been more absorbed in placing an order on a façade, than in disposing the building elevated behind it conveniently. The colonnade of the Louvre is made most contrary to reason in this respect, because its order has no relation with what it covers, and the immense portico situated on the first floor only serves to obscure the windows opening in its length; nor do you ever see any one promenading on its area. But they must be majestic at all hazards. We have not entirely recovered from these serious follies, and you may still see these orders placed, for no imaginable reason, in front of buildings which could easily dispense with this parasite decoration, intended to prove to the public that there exist orders, and architects to put them in proportion according to the formula.

"But you will study these parts of architecture a little later. I think it a bad way to teach art, to throw flowing language into the lesson, before being able to express the thought clearly; and this is what is done by authors and orators who take bifalutin for healthy rhetoric; and architects who, before thinking of fully satisfying the demands of the construction, or of studying the needs of their day, amuse themselves with reproducing forms the origins, reasons, and true meaning of which they have not understood. For the moment, let us stick to our immediate subject. We are building a

house, not a temple or a basilica; we must study all its parts. This task is enough for us.

"We have leisure to study well the details of our building, as the cold weather has forced us to shut up our work-yard. Construction, my friend, is the art of foresight. The good constructor leaves nothing to chance, postpones no solution, and knows how to give each function its place, its value in relation to the whole, and this at the opportune moment. We have drawn the plans of the different floors, and given the necessary details to the construction of the lower parts of the house; now we must combine the details of the elevations with the whole. We will first establish the exact profile of the front walls, with the height of the floorings, the levels of the grapplings, and the shafts of the roof."

The cousin, who had, as may be supposed, conceived, if not traced, beforehand, all the parts of the construction, soon exhibited this profile to Paul, who marvelled to see how quickly his teacher could trace a detail of construction on paper. He once more alluded to this.

"How can you indicate, without hesitation, the arrangements of all these parts of the building?"

"Because I have thought about it, and have represented all these parts to myself, in tracing, or making you trace, the general outlines. If they are not on the paper, they are in my head; and when it becomes necessary to render them intelligible to those who are charged with the execution, I

have only to write down, so to speak, what I already know by heart. Look at this profile and these few details (Fig. 42); examine it all together; you will soon perceive that you have already seen all that this sheet of paper contains, and that with a little attention you might arrange these diverse parts. You see figured the thickness of the ground-floor wall with its dotted axis; the height of the allaying *A* and its support; the disposition of the frame of the window; its lintel; the height and thickness of the flooring. The string-course *B* was to be fixed; it should have the same thickness as the flooring. Then, reducing the front walls to 50 centimetres on the first floor, we place an 'offset-course' at *C*; the allaying like that of the ground-floor. The height of the first floor from ground to ground has already been fixed. The member *D*, below the cornice, has the thickness of the second flooring; it remains to place the stone coping above to receive the gutter. As for the window of this first story, it is constructed like that of the ground-floor, only the splaying is less deep by 10 centimetres, as this wall is 10 centimetres less in thickness. Its lintel is the same, as well as the frames which are to receive the cloth blinds; and the grapplings pass under these lintels. As we have gables, the cornices cannot turn, and must stop against a projection *E*, which, in rising above the roofing, enables us to place the coping *F*, which will have a projecting fillet to cover the meeting of the slating with this gable. I trace then at *G* the angle of the building with this projection

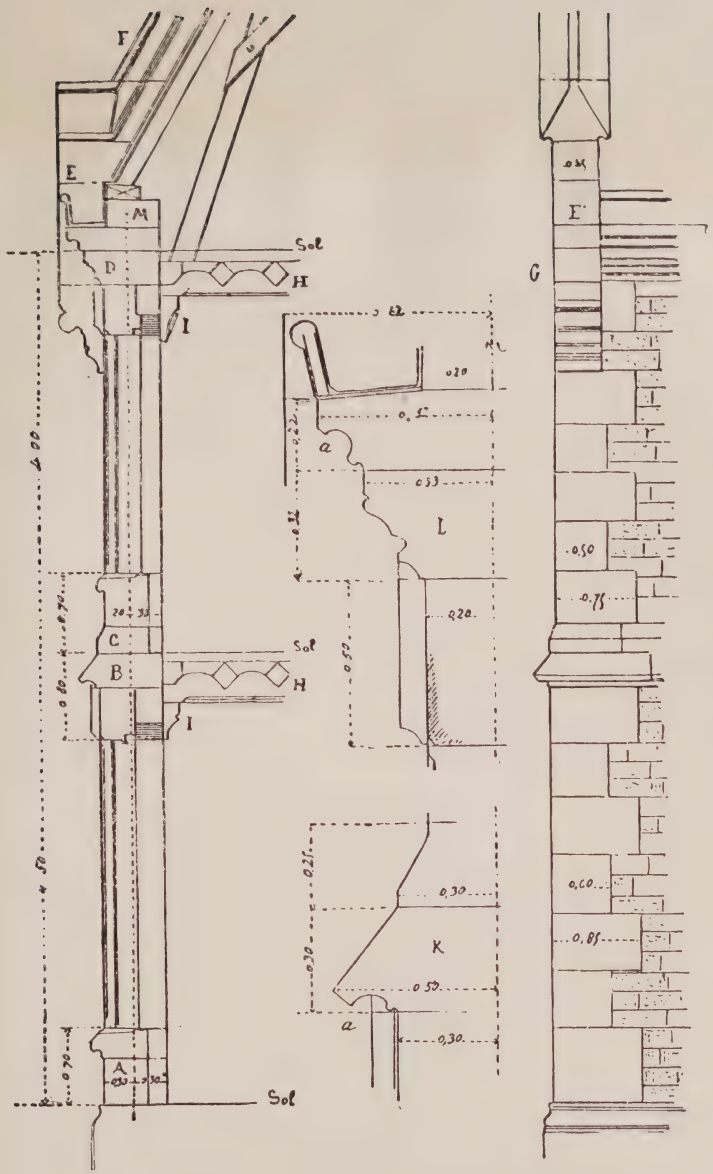


Fig. 42. — SECTION AND DETAILS OF FRONT WALL. — Page 184.

E, and the dressing of which we have spoken. As I perceive that the joists will have too much span at certain points, I place the intermediate beams *H* to receive them, and the corbels *I* to relieve the span of these beams.

"I have traced at *K* the string-course of the first story with the projections flanking the axis of the wall, the offset-course above, then at *L* the cornice and crowning coping. You will observe that this coping gives an inclination towards the exterior, under the gutter, so that if a leakage happens the water will run outside and will not penetrate the masonry. This coping carries a larmier *a*, as well as the string-course, so that the rain may not drip along the walls. These profiles will, besides, be traced of the size of the execution, for the stone-cutter. The dormer-windows for lighting the attic story will rest upon the surface *M*. I will later indicate to you what the carpentry work ought to be. Take these sketches, and make designs from them on a scale of 5 centimetres per metre, so that they may serve for the execution.

"Meanwhile I am going to make for you a sketch in perspective of the bay-windows, or alcoves of the billiard and dining rooms, by aid of which you will be able to establish these details. We shall see how you will acquit yourself of it.

"The English, in their country-houses, usually employ this sort of projecting 'cages.' They call them 'bay-windows,' and often construct them in corbelling. See, here is a sketch, in this memorandum-book, of the window of a

house at Lincoln, built in the sixteenth century (Fig. 43). This projecting lodge, carried on a bracket, is terminated by a little terrace which forms a balcony on the first story. Observe, in passing, how well planned this construction is. That part of England possesses stone, but this material is less common than brick. The builder has only used the dear material for the bay-window, which he could scarcely erect in brick, and for the jambs and lintels of the windows. The rest of the building is erected in brick. But we give too much of a projection to your bay-windows to carry them in corbelling."

"What do you mean by 'in corbelling'?"

"It is a construction in projection, without foundation, but sustained by corbels; whence the word 'corbelling.' The weight of the masonry reposing on the lower end, the part resting on the corbels, enables us to establish on their projecting part a construction which, being less than that reposing on their pendant, is thus maintained without fear of a seesaw. You must still calculate the length of the arm of the lever, that is, the relation of the projection of the corbels with the weight which sustains their pendant and that which reposes on their head. The more projecting the corbels, the more the weight placed on their exterior extremity acts upon that which maintains the lever; so much so that a very slight weight placed at the extremity of a very much projecting corbel might make a heavy construction, put at the

Fig. 43. — A BAY-WINDOW. — Page 186.

Fig. 44. — THE BAY-WINDOW FOR THE BILLIARD-ROOM. — Page 187.

end, seesaw. Corbels have often been replaced by 'gatherings over,' a system of apparatus which carries the extreme weights on the walls. The architect who designed the window that I have just shown you did not pay attention to these combinations. He made what is called a pendant, or bracket, that is, an inverted pyramid, by means of three courses in corbelling, or, if you will, in projection one over the other, so as to obtain a part of a polygon. On this platform he erected his opening, which is about 24 c. in thickness. The pendant being held in the construction of the wall, supports, by the weight of the latter, the openwork, without seesawing. This kind of balconies was much affected in the Middle Ages, since they afforded room in the upper stories without encroaching on the public road, and because they gave side views. If the rules relating to public ways do not permit these projections in our cities, nothing forbids their being employed in country-houses. But there must be a good reason for building them. In our case, these constructions in corbelling have no object, and it would cost us less to carry our bay-windows to the ground."

An hour later the cousin handed to Paul the sketch represented in Fig. 44, giving the disposition of the bay-window of the billiard-room, that he might study its construction. This task required a good deal of attention on the part of our inspector of works, and he could not bring it to a successful result until he had asked much advice and information of his cousin.

CHAPTER XIX.

CONTINUATION OF THEORETICAL STUDIES.

THE weather became more and more unfavorable to a resumption of work. The constructions begun were concealed under a thick bed of rubbish and earth, covered in its turn by a heavy mantle of snow. The days passed in studying the details which were to be given to Papa Branchu and the carpenter, when the weather should permit work to be begun again. During the long evenings theoretical questions were discussed concerning the art of building, after the news of the day had been disposed of. For Paul this was a means of instruction, and for the family a distraction in the midst of the thoughts which weighed upon all in those melancholy times. Paul had seen his cousin draw, during the day, a certain number of profiles, or sections of the size of the execution; and as he himself had designs to copy out, he had not stopped to question his instructor. But in the evening he asked how these profiles were drawn.

"You want receipts for everything, Paul," replied the cousin. "But there are no receipts for drawing profiles, any more than there are for the other parts of the construction. The

destination, the nature of the materials, the manner of putting them to use, the effect to be obtained, all impose various conditions. To these add good sense, observation, and study, and you will be able to draw profiles. Let us resume, if you please, these conditions, one by one.

"The destination: A profile, let us suppose, is made to fulfil a certain object; if you draw a cornice, it is to crown a wall, carry a gutter, or the forward part of a roof, to divert the rain from this wall. Then you must make the cornice sufficiently projecting to accomplish this object. The nature of the materials: It is clear that if you possess stones which are resisting, tenacious, furnished in large pieces, or stones which are thin and friable, you cannot give the same profile to these two different kinds of materials. The method of placing these stones should also have an influence on the form of the profile. If we have to raise them by simple, primitive means, which do not allow of the raising of heavy weights to tolerably great heights, or if you possess means for the latter object, in the first case, you must avoid profiles which require large blocks; in the second, you can adopt such. The uses: You must necessarily take account of the usages of the locality where you build, since these result, most frequently, from a judicious observation of the conditions imposed by the climate, the needs, the method of work, and even the nature of the materials. I mean, by usages, not certain imported methods which are a

matter of fashion, and are not a consequence of the conditions I speak of, but those which are furnished, as I have just said, by long and prudent observation. The effect to be obtained: The capable architect is able, by the aid of the drawing of a profile, to give a robust or delicate aspect to a construction. He should always subordinate the drawing to the scale of the construction and of the materials. It is ridiculous to pretend to obtain large profiles, if you only possess low bank stones, or those of a kind little resisting, as it is absurd to make delicate profiles of large stones difficult to be cut.

"You see, the receipt in this, as in everything that relates to the art of building, is first to reason.

"The Athenians, who built monuments in white marble, were able to indulge in delicacy in the tracing of their profiles, which could not be applied to the gross limestones of our own country. And when the Greeks built edifices with stones of a porous nature, with large grains, they were careful to cover the edges with a very fine coating, which enabled them to conceal the grossness of the material. But while they could adopt this method in a soft climate, it could not be done with us, where the thermometer descends, on an average, during the two winter months, to four degrees below zero, and where some days, as now, it reaches —15°. The coatings would have to be renewed every spring.

"Our architects in the Middle Ages, who did not follow

what was called the classical methods, which are now professed in our School of Fine Arts, and who did not go to Rome and Athens to study the art of building as suitable to France, sought to draw profiles in harmony with our materials and climate, as seems reasonable; well, they found and practised this sort of profile drawing. I will furnish you with a proof of it.

"At first, as they did not make rough-coatings, as I have told you, but placed stones all cut, without having to retouch them when once in position, they were obliged, necessarily, to trace each profile in the height of a course. If these were high, their profiles might be large; if low, their profiles were small.

"Let us take, for instance, a string-course. A layer of stone which indicates a flooring is called a string-course; an intermediate rest in the height of a wall. It is not without good reason that a course which makes a projection outside is placed at the level of a flooring: first, because it is good to give more strength to the wall at this point, where it receives the mortises; secondly, because the construction must be 'flushed' to this same level, to regulate it for ascending to a new story. But this course must not arrest the rain-water, and thus provoke the penetration of moisture in the walls; on the contrary, it must be so profiled as to divert this humidity, so that it shall not rot the wood. Here, then, you see at *A* (Fig. 45) how architects, who thought more of satisfying the necessities of the construction than of borrowing forms from

edifices having no relations with the conditions imposed by our climate and our kind of structure, usually profiled a string-

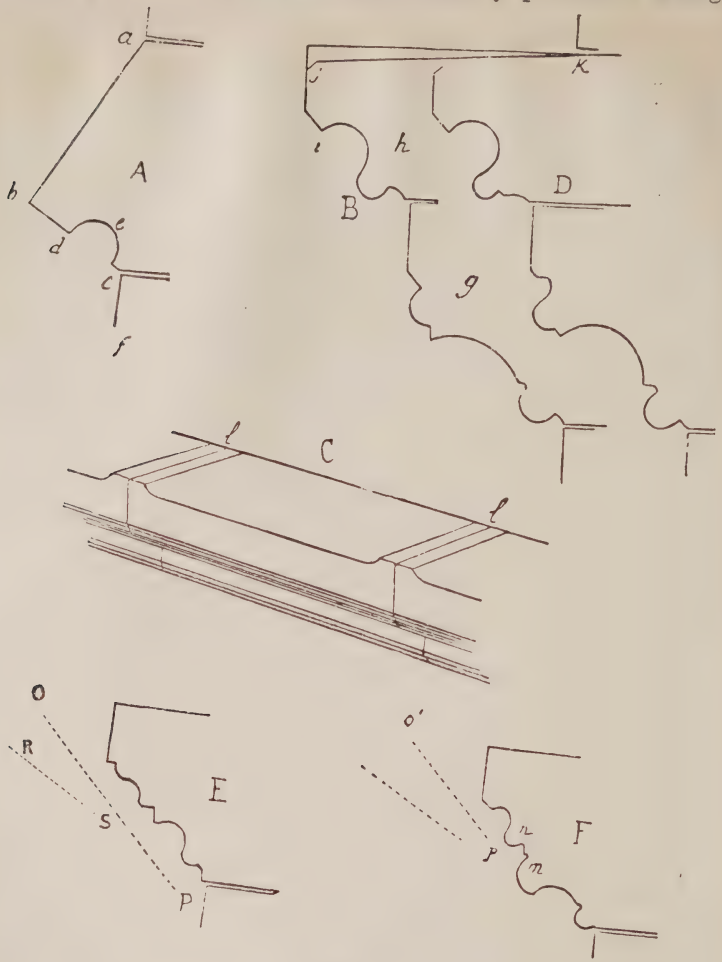


Fig. 45.

course. They traced the line *a b* according to an angle of 60 degrees. From the point *c* they carried down, on this line *a b*,

a perpendicular *c b*. The angle *a b c* was, then, a right angle. Taking from *b* to *d*, a length more or less extended, according to the resistance of the stone, they hollowed out the moulding *c*; so that the rain-water, falling on the inclined surface *a b*, did not stop, followed the inclination *b d*, and fell from *d* to the ground, since it could not remount in the hollow. Thus the facing of the wall *c f* was protected. If a cornice were in question (see *B*) they established a first course *g*, intended to support the projection of the coping *h*; then they placed, as a second course, this coping *h*, taking care to put a hollow at *i*. If this coping were to receive a metal or stone gutter, they took care to cut an inclination from *j* to *k*, leaving the horizontal layer at the right of the joinings, as shown you in the tracing in perspective *C*. The gutter, then, was carried on these reserves *l*, and if any water escaped by the joinings, these infiltrations, finding the inclination *k j*, followed it, reached the hollow *i*, and fell to the ground without penetrating the thickness of the wall.

According as the stone used was hard or tender, the mouldings were more or less solid or soft. Thus, let us suppose in this case that the profile has been cut in a stone of medium hardness, while, if this stone is very resisting, you might sharpen the profile as I indicate in *D*. You will then obtain a more decided effect, deeper shadows, more brilliant lights. But the inclination of the sun's rays must always be considered in tracing exterior profiles.

If, for instance, you trace a profile such as that at *E*, it is evident that, the sun's rays following the direction *O P*, all your mouldings will remain in the shade and will produce no effect. But as soon as the sun descends so as to follow a more inclined direction, *R S*, all the mouldings will receive equal threads of light, and the profile will give a succession of shades and lights conformable to the figure *F*; the sun's rays, following the same direction *o' p'*, will meet the projections *n m*, which will be luminous, and this direction descending, you will always have the contrasts between the shadows and lights. I am now giving you general views; it is for you to observe and derive profit from your observations, when you have occasion to study monumental structures.

It is also very important to subordinate the drawing of profiles to the nature of the materials used. You cannot give profiles which are proper to stone, to a cast or drawn-out matter like plaster, cements, and mortar. These coating materials only permit a fine and little projecting moulding. So, also, if you give profiles to woodwork, you must trace them in accordance with the ligneous and tenacious quality of wood, avoiding too large surfaces; nor must you lose sight of the fact that wood lends itself to delicate work, is only put in use in relatively thin pieces, and requires, for being conveniently worked, the use of narrow tools, such as scissors, planes, and jointers, which run according to the grain, and

cannot be used for surfaces, and wide extents. In all this, economy is in accord with common-sense and the good effect produced; for, if you impose a profile tracing which does not agree with the material used, you provoke the employment of unaccustomed, difficult, and therefore expensive methods, and your work appears labored and far-fetched. There are architects who think they will astonish by thus adopting methods not in accordance with the materials which they put into the work; who, if they build in bricks, strain to give the appearance of a stone structure to their building; who pretend to imitate marble with carpentry, or carpentry with coatings; who seem, in short, to labor to give forms to each material used, not appropriate to its quality. Take account of these unhappy methods, so as always to avoid them, if you wish to be an architect. False taste, with most of those who engage in building, is often an obstacle to the employment of sensible methods; for unhappily, with us, classical studies have forced artists into this false path, and therefore the public has acquired a passion for the melancholy results to which it leads; so much so, that it is often difficult to make those for whom you build listen to reason, and proceed according to what is enjoined by a wise regard for the employment of the materials. Never mind; there are subjects on which an architect who respects his art ought never to yield."

"It is, indeed," said M. de Gandelau, "a strange mania

with certain people who build, to assume to impose the most ridiculous fantasies on their architects; nor does this date from to-day, as Philibert de l'Orme complained of it as far back as his time."

"Philibert de l'Orme," said Paul, "was, I think, the architect who built the Tuileries?"

"Yes, in part, at least," said the cousin. "Have you not his book in your library?"

"I have, and will go and get it for you." M. de Gandelau soon returned with a venerable folio.

"Here," said he to his son, "I give it to you, and you will do well to meditate its pages. Here is the title of the preface: 'Singular advice for those who undertake to build flippantly, without the advice and counsel of learned architects; and the faults which they commit, and the inconveniences which result therefrom.' It shall be the beginning of your architectural library, if you choose that profession; and you could not read a work better calculated to inspire wise sentiments, and respect for the calling. I cannot speak professionally, as I do not understand the art; but by reading some of these pages, I have at least spared myself the expensive experiment of some proprietors, to wish to erect their own buildings."

"Philibert's sincerity was not very profitable to him," said the cousin.

"Perhaps not; but he left a book which makes him esti-

mable as a man, independently of his merits as an architect, three centuries after its publication; for it is dated 1576. This advantage compensates for some drawbacks during life; for people are not liked for speaking the truth, until they are no longer here to receive the price of their sincerity from public opinion."

"Hum; then we must not be surprised that few dare to announce these truths, and that architects, since they are still living, prefer the calm and well-being which complaisance toward their employers procure for them, though there may be late regrets and useless expenditures, to this posthumous glory."

"Come, come," said M. de Gandelau, "you are not one of these architects, and yet you have an excellent business; I know not whether you will be talked of three centuries hence, but I know that you are esteemed now."

"Then your judgment a little while ago was not an absolute one?"

"No, surely; the way of putting things is much in all this, and there is a manner of telling the truth. You will agree, however, that you have lost more than one contract from having been too sincere at the beginning?"

"No doubt; it is even probable that, if I had not been served by certain favorable circumstances which put me in relation with clients used to a large scale of operations, with men of minds too elevated and serious to occupy themselves

with the details of our art, I should have had little to do. In general, you are right, and most persons who have constructions erected, hesitate to apply to architects familiar with their profession, but independent in character. What they seek (and in this women often have an unfortunate influence) are complacent mediocrities, who lend themselves to all their fancies, to repent of it shortly afterwards."

"You attack us unjustly," said Madame de Gandelau. "Women do not presume to understand architecture, nor do they ask for anything but a good arrangement of the interiors; which is very natural, as they have the direction of the household affairs, and suffer more than any one from inconvenient or bad arrangements in houses."

"Agreed; but on the one hand the housewives ask for distributions for their convenience, which are often complicated and demand special arrangements; and, on the other, the masters wish exteriors which betray such a style, or such an aspect; so that it is difficult, if not impossible, to conciliate these two exigencies, which are often antagonistic. The unhappy architect, desiring to please everybody, to harmonize the contradictory demands, obtains nothing good; and, the work finished, each in his turn throws a stone at him. How many times I have been called upon to repair the blunders which were the consequences of these disagreements and unlucky complaisances of the architect! I have then been told how sorry they were not to have engaged me to direct the

work! It was a trifle late, and this example did not serve others."

"What is to be done?" asked Madame de Gandelau. "If the matter is as you say, you offer Paul a career which seems to me nothing better than a blind alley; and unless he receives an engagement in government works —"

"O, that is a chance too remote! besides, a career which depends on the government is no career at all. A man must learn how to get along without counting on such very precarious aid. Then, the elect are but few in number."

"Well?"

"Well, it is necessary to learn, to acquire knowledge and reason, the habit of observing everywhere, and above all in the rising generation. When the people of the world, when those who have buildings erected, and who are, therefore, favored by fortune, know a little more than they do now, they will perceive that everything remains to be learned in no matter what branch of knowledge, and that the best way is to repair to special men in dealing with special matters, and to let them deal with them. No one ventures to give advice to a surgeon who is tending a wounded man, as to the manner of performing an operation. Why does everybody interfere to give his opinion to an architect, on the way in which he ought to manage a construction?"

"It is not quite the same thing."

"Almost; only, madame, as it is a matter of life, no one

breathes a word to the surgeon; but, as architecture only concerns the purse, and sometimes the health, at the expiration of the work, every one has his say to the architect."

"Well, we have wandered far from the profiles," said M. de Gandelau, rising.

CHAPTER XX.

A HIATUS.

A FEW days after this conversation, a large body of troops crossed that part of the country. The Germans were manœuvring on both banks of the Loire, and menaced Tours. A general came to take up his quarters at M. de Gandelau's. He was an acquaintance of the cousin. The latter was becoming very impatient of the inactivity to which he had been reduced since the war had taken so serious a turn.

He had a long talk with the general in the evening, and the next morning he declared to M. de Gandelau that he should leave with the troops who were passing to the seat of war; that able officers were wanting, and that in the exigency he might fulfil an officer's duty; that his friend the general highly approved his decision; and that, under circumstances so grave, he thought it his duty not to hesitate to go, since he might render some service to France. M. de Gandelau did not try to retain him, being too well aware of the motives which decided his guest.

"What shall we do with Paul?" he asked.

"Have you a Latin edition of Vitruvius in your library?"

"Yes."

"Well, confide it to me; I will, before going, explain to Paul in a hour how to work at this treatise: this will prevent him from forgetting what Latin he knows, and he will profit by it in the studies which we have begun."

"An excellent idea."

"You will require Paul to give you, twice a week, the translation of a chapter, with explanatory designs; this will keep his hand in and occupy his mind. I don't suppose his translation will eclipse Perrault's; but no matter, he will not wholly lose his time. As soon as I can return, you will see me."

Paul was much grieved at his cousin's departure, and his own inability to follow him; he would have preferred to continue his studies on the art of building by a course of military engineering on the ground; but this would have been annoying to the cousin, and Madame de Gandelau would have died of anxiety. Paul was provided with Vitruvius, and the work prescribed was explained to him.

Two hours after, the cousin, armed with a small valise, took up his march with his friend the general, whose troops were proceeding towards Chateauroux. Promises to write were made on both sides.

It may readily be imagined that M. de Gandelau's house assumed a very gloomy aspect after this sudden departure.

Its master had, from the beginning of the war, equipped and sent off all the healthy servants and work-people. Only two or three old domestics, and several women, the husbands or children of most of whom were in the army, remained at the château. M. and Madame de Gandelau no longer inhabited the drawing-room, where beds had been disposed for the wounded, in case any such came.

When the cousin had gone, Paul went to visit the work-yard. It was deserted; the snow covered the stone-work, the freestone, and the sparse carpentry. The walls raised to a certain height, protected by the rubbish, surmounted by a sheet of snow, their faces browned by contrast with the white shroud which surrounded them, some pieces of wood blackened by moisture, gave to the outlines of the construction the appearance of the débris of a fire.

Though Paul, at his age, was not easily accessible to gloomy thoughts, the poor boy, on seeing this solitude, could not repress his tears. He imagined this work-yard as it was a month before, all alive with men engaged in their work. All were gone. The soul of this future house, which represented for him the joy of the family, had just quitted it.

Despite the cold, he sat down upon a stone, and with his face between his hands, gave himself up to sad reflections. It was the first grief, the first unlooked-for hardship, which he had suffered; it seemed to him that all was over, and that there was no longer any hope or possible happiness for him in the world.

A hand, placed on his shoulder, made him start; raising his head, he saw his father behind him. His first movement was to throw himself, sobbing, into his father's arms.

"Come, calm yourself, my boy," said M. de Gandelau. "We live in times of trial; who knows what is reserved for us? Perhaps they have hardly begun. Think what grief there is at this moment in France! What are our anxieties and troubles beside that anguish? Keep your tears; perhaps you will only have too much occasion to shed them hereafter. There is always time to despair. I saw you coming this way, and followed you, foreseeing your grief. But what is it for? Nothing, or a trifle, at least. Return bravely to work, alone, since our friend has left us to fulfil a sacred duty. He will come back; you have learned to love and esteem him more and more; show him that you are worthy of the affection he has evinced for you, in giving over to him then the results of serious labor. He would certainly be touched by your grief, in which we earnestly sympathize with you; be assured that he will be still more touched to see that you have scrupulously followed his parting instructions, and that his presence is not the sole motive which impels you to love your task."

Father and son returned to the house. M. de Gandelau's advice, and the care with which he led Paul to look forward to brighter days, had little by little restored to the latter, if not gayety, at least calmness, and the desire to do well.

M. de Gandelau above all feared that his son would be discouraged, and would acquire the vague and fruitless melancholy with which youth sometimes loves to nourish itself, and which enervates the best endowed minds.

He went then to Paul's room, and taking up Vitruvius, began to look it over. M. de Gandelau was well-read, though he never made a parade of his knowledge; it was a gift which he reserved to himself. Familiar with the classical authors, he could read — if not explain everything as an architect — the text of Vitruvius.

"See," said he to Paul, "here is a chapter which must be interesting, and will teach you a great deal; it is Chapter VIII.: 'De generibus structuræ et earum qualitatibus, modis ac locis.' How do you translate this title?"

"'Of the kinds of constructions and their qualities, with reference to their uses and localities,'" replied Paul.

"Yes, that is it; but in looking over this chapter I see that it only treats of masonry; the author, in using the word 'structura,' seems to me to refer only to constructions made of brick or stone. A better translation, perhaps, would be this: 'Of the different kinds of masonry, the properties of such structures, by reason of their uses and local circumstances.' Well, go on and translate this eighth chapter. I see that the author describes the natures of masonries, the use of which he recommends under this or that condition. Come! Have good courage, and imagine

that your cousin is here all ready to correct your mistakes."

Paul set to work, and tried to illustrate each of the descriptions of Vitruvius by sketches. Of course this gave him much trouble; many of the words were unfamiliar to him, and the dictionary aided him but little when he wished to discover their exact meaning. Yet, little by little, the work absorbed him. He tried to recall the buildings he had seen, so that he might understand the author; he recollected some of his cousin's instructions; and, somehow or other, as he studied and translated, he put very tolerably drawn sketches on paper, though they were not always the true expression of the author's description.

During the latter part of December and the early part of January, he succeeded in translating a dozen of the chapters which his father selected, and in illustrating the text. This made him eager to know the contemporary monuments of the author, and he examined with great interest some engravings of Piranesi, representing the antiquities of Rome, which his father possessed. M. de Gandelau had advised Paul to write down the questions which the study of Vitruvius suggested to his mind, to submit to his cousin when he came back. The days thus passed quickly away; and though sadness and anxiety darkened the hours, M. de Gandelau employed himself ceaselessly with assuaging misery out of doors, and organizing the defence against the invaders, Paul worked

bravely and saw his note-book filling up, and Madame de Gandelau organized a sewing-circle with the village women, for our poor soldiers deprived of everything. When evening came, the members of the family still assembled with the secret joy inspired by duties fulfilled.

A few days after, the cousin returned, and, it is needless to say, was welcomed with open arms. Paul was wild with joy, and they at once began to talk of resuming the works. Marie's last letters announced that she should return towards the end of the following winter. These letters, full of anxious thoughts, of anguish experienced far away from France, made no allusion to the future house. If, then, it could be finished, the surprise would be complete. While the cousin was taking the rest necessary to him, he read over and corrected Paul's translation, and rectified his sketches. The whole was copied out; and thus arrived the first days of March, when it was decided that the work-yard should be once more opened.

CHAPTER XXI.

RESUMPTION OF BUILDING. THE CARPENTRY WORK.

THE weather was fine towards the middle of March; the work was resumed, and it became necessary to give the carpenter the details requisite for the completion of the floorings and roofs. Paul now more readily understood the sketches drawn by his cousin, and began to be able to make himself useful. He had adopted the excellent habit of asking for explanations when at first sight he thought he could not faithfully interpret a summary tracing; nor was the cousin chary of his explanations and comments. His patience was inexhaustible. Whenever Paul was perplexed, and could not solve a difficult question, the cousin, before setting him right, let him try for a while to unravel it.

"Reflect," he said; "you will always find a solution; if it is not a good one, I will come to your assistance; but you yourself must find out something. You can only thoroughly comprehend the solution of one who is experienced, after you have turned the subject over, and made several efforts to solve the problem yourself. It is a very necessary preliminary exercise, and prepares the mind to understand. Make

a general section of the principal building, on the billiard-room and your brother-in-law's study, — that is, a transversal section, which will indicate the walls, floorings, chimneys, and roofs. You have nearly all the needful elements. Try to combine all this, so as to take account of all the parts of the building. I will not look at it till you have finished. Then I will correct it, and the corrections will be of use to you."

Availing himself of the details already traced, Paul drew, not without difficulty, the transversal section; but the carpentry work of the roofs was awkwardly designed, and its composition seemed difficult and complicated to him. He did not know how to close the wide opening uniting the billiard-room with the drawing-room. The dormer-windows in the roofs caused him serious trouble. Then he had much difficulty in arranging in his mind the joining together of all these parts. However hard he tried, he could not clearly represent to himself the position of each. He was not satisfied; and he told his cousin so, plainly.

"I am very glad," replied the cousin, "that you are not satisfied! That would be a bad sign, for it would prove that you had not made a serious effort. Your walls are quite in place, according to the profile which we have adopted. But the carpentry and the dormer-windows! All that cannot remain, — it lacks simplicity. Why so many pieces of wood? Have you made account of their utility? We have walls;

let us profit by them. Why not make use of the wall which separates the billiard-room from the study, to carry a part of the carpentry work of the roof, inasmuch as this wall receives the chimney-shafts, which must necessarily be carried above the roof? You have not thought of the chimneys; it was foolish, for you have them indicated on the plans of the ground-floor, first story, and attic."

"I thought of them," rejoined Paul, "but I did not know how to carry them up."

"Then you have not traced them, which is a means of avoiding the difficulty; but you know well enough that they must pass above the roof! I do not allow you to put a difficulty aside; that is no way of solving it. Come, let us look at all this together."

The section was soon corrected (Fig. 46), and the cousin did not fail to furnish it with the details which the rooms on which the section was made were to receive. This pleased Paul very much; he thus saw the billiard-room completed, with its opening upon the drawing-room; his brother-in-law's study, with its doors; then, above, his bedchamber and toilet-room, and the two rooms in the attic. He thought the drawing charming; he seemed already to be entering the rooms, and enjoying his sister's surprise in looking about her. He was anxious to show these fine things to Madame de Gandelau at once; but the cousin exhorted him to patience.

"All this signifies nothing," said he, "it is only an image;

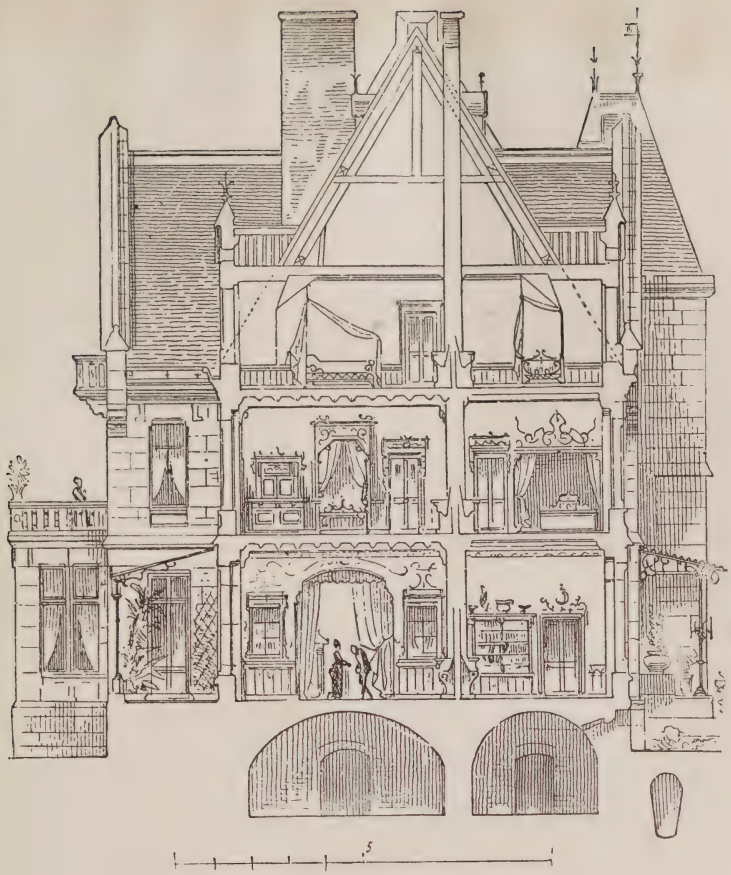


Fig. 46. — SECTIONAL VIEW OF THE HOUSE. — Page 210.

we must consider the wood-work and interior in detail, and there is much to correct and revise in making this study. Let us leave the interior for a while, and examine the carpentry work of the roof. Here is a plan of it (Fig. 47).

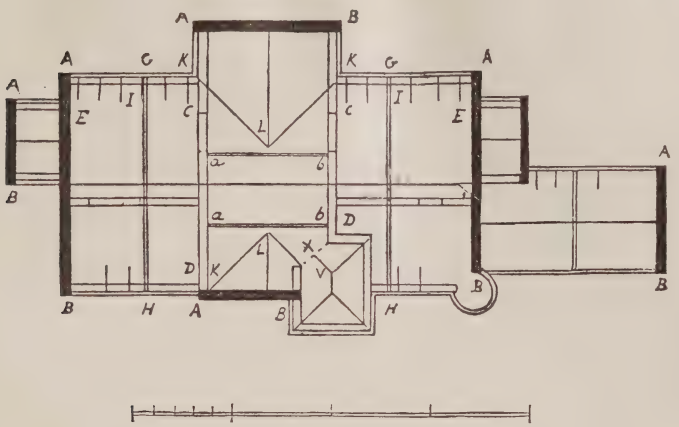


FIG. 47.

The walls *A B* are the gables which are to carry the bindings, or purlins. We have, at *C D*, two channel walls which also form gables and receive purlins. But the spaces *E C* are too wide to receive purlins from *E* to *C*. Between them we reckon 6 m. 60 c.; but the purlins should not be more than 4 metres in extent, to avoid flexion. We must then place intermediate ribs at *G H*, along the reveals of the middle dormer-windows *I*. Thus the purlins from *A* to *G* will be only 4 metres in length, and we can relieve them by trusses on the sides of the extreme gables. From *K* to *L* we shall have

branches of gutter-leads at the penetration of the roofs. Let us establish the ribs *G H* (Fig. 48). The height, between floorings, of the attic story, must be 3 metres. We will, then,

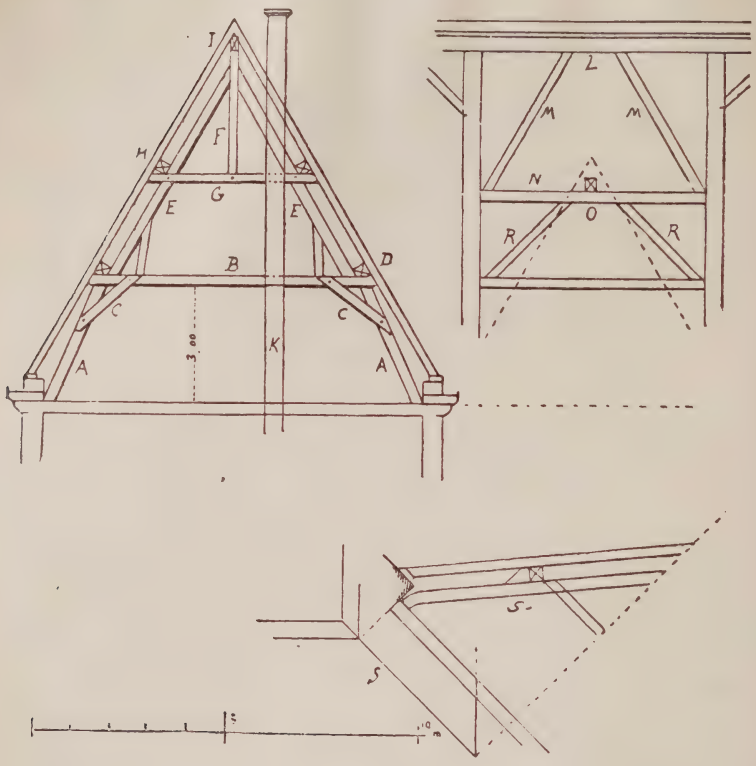


Fig. 48.

place the two rafters *A* on two sleepers joined by a tie-beam which will pass under the floor; on these rafters, a tie-beam *B*; then, to unite the rafters with the tie-beam, the braces *C*.

At the extremity of this tie-beam will be the purlins *D*. The main rafters *E* will come upon this tie-beam, and will seize the king-post *F*. Under the second purlins, *H*, must be placed the braces *G*, forming a turned-up tie-beam. The ridge-tree *I* will carry upon this king-post with oblique trusses. These purlins will carry from the other end on the gables. Thus we can place the laying on of the rafters which will receive the scantling, and slating.

"These pieces (tie-beams, reverse tie-beams, main rafters) might pass across the longitudinal wall *K*, receiving the chimney-shafts; and the carpentry will prop up this wall, and, reciprocally, the wall will relieve and tighten the carpentry work. For the middle of the structure, having the two walls *C D*, it will suffice to place the ridge *L* with the two reliefties *M*, united at the extremities of a purlin *N*, which will hold them from moving. We will place the purlins *a b* (Fig. 47), which will receive the ridges *O* of the roofs in penetration. These ridges will also be relieved by the ties *R*. The branches of the gutters *S*, repeated at *S'*, will unite upon these ridges *O*. The raftering will thus be everywhere well established, and we shall only have a little wood to put to use, relatively to the surface of the building, as we shall avail ourselves as much as possible of the interior walls. The gables enable us to avoid hips, which are difficult to establish and cover, and require a great deal of wood. The roofing of the staircase remains. To show you the method of constructing it, I will

give you a drawing in perspective. This roofing is supported on the walls which rise above the cornice of the structure, but it penetrates the roof of the main structure at *X* (Fig. 47). You will observe, in examining the drawing (Fig. 39), that the walls of the staircase leave an angle without a resting-place, on the hall. We must, therefore, carry the hip of the roof on this vacant space. For this purpose, we will place a dormer-truss on the two heads of the wall, which will receive the end of this rear hip *V*, indicated on Fig. 47. This arrangement may be seen on the drawing in perspective (Fig. 49), which shows the square tower of the main staircase, with its carpentry work. We will raise the lop-sided newel *A* of the staircase to the level of the cornice; we will place wall-plates *B* on the walls; then the ground-plates *C* on the three angles of the newel. On the ends, united at the middle of the latter, we will raise two king-posts *D*, and the three hips *E*. The foot of the two king-posts will be united by the braces *F*. As for the rear hip *G*, it will join the face of the king-post of the dormer-truss, as I have drawn at *G*; and that this dormer-truss may not be pushed out of place by this hip, the braces *H* will unite the head of the king-post of the dormer-truss with the king-post of the roof *D'*. On the angles of the hips, at *I*, we must fix brackets to place the ends *K* of the purlins, which will relieve the span of the rafters.

"At *L* you see the gable which is to join the staircase roofing; and do not forget that you must incrust, along the walls

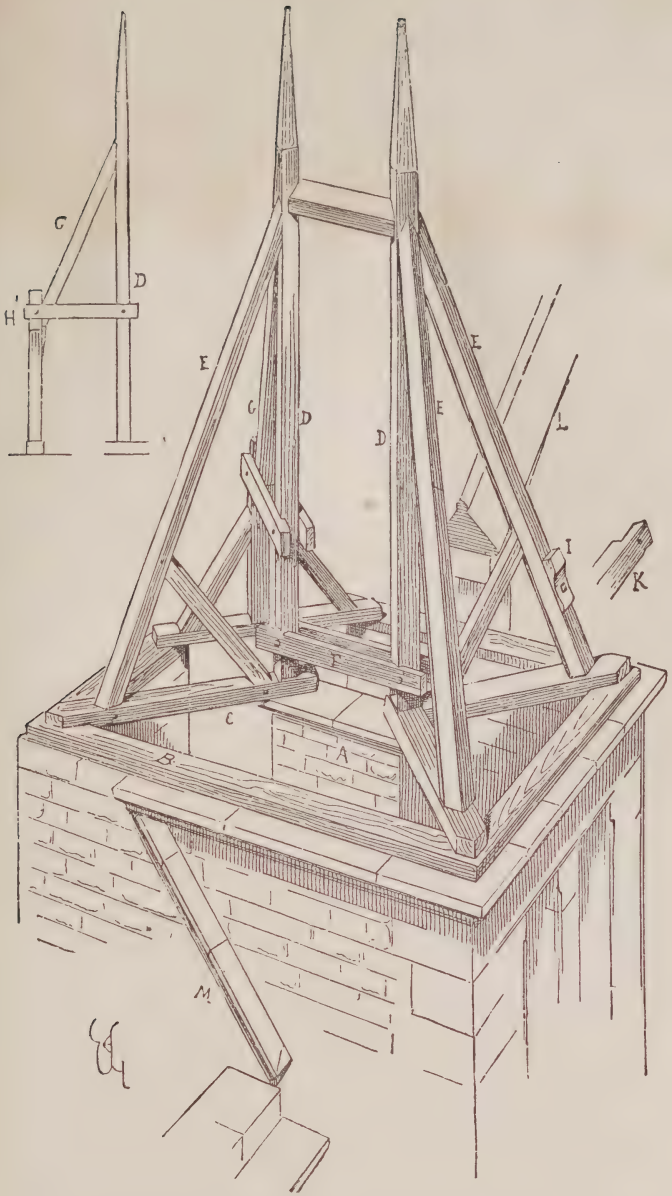


Fig. 49. — ROOF OF THE MAIN STAIRCASE. — Page 214.

against which the coverings in penetration are traced, stone fillets *M*, which form 'pads,' or 'solins,' above these coverings, to prevent the rain-water from passing between the slating and the wall. These 'pads' are most often made of plaster or mortar, on the covering itself; but the latter being subject to motion, they are apt to become unstuck, and must be constantly repaired. Being incrusted in the masonry above the inclination of the covering, they shelter the junction of the slating or tiling with the walls; and being independent, they are not subject to be damaged by the motion of the carpentry work.

"Please trace this carpentry work on a scale of two centimetres the metre; I will correct your drawings, and we will give them to the carpenter to establish the wood-work as soon as possible. We will indicate the sizes of the wood-pieces. Thus, the main rafters should be 20 c. × 18 c., the braces 8 c. × 18 c., the king-poles 18 c. × 18 c., the tie-beams the same, the shanks 20 c. × 20 c., the rafters 8 c. × 10 c. The purlins 20 c. × 20 c. at the most, and without sap-wood or flaws."

"What are 'flaws'?"

"They are depressions, lack of material which appears on the edges when crooked wood is cut, and which thus leaves the sap-wood visible, and even a concavity, on these edges, as I show you in *A* (Fig. 50). You will take care not to allow flaws in the wood which the carpenter uses for the roofs and joists.

"In studying our floorings, I see that, in the cases of the billiard-room, dining-room, and drawing-room, we shall do well to put two beams in each of these rooms to receive the joists, by reason of the extent and partitions above these floorings. You recollect that we reserved this question, and that in the drawing (Fig. 42) and the section (Fig. 46) we took the position of these beams for granted. The joists in these three rooms, in place of going from one lateral wall to the other, will carry 'wall-gables' on these beams.

Fig. 50.

But these beams were of the best oak, and by bending, which is at least unpleasant to the eye. We will make, therefore, each of them with two sawed pieces, as I have already described to you, and we will interpolate between the two pieces a strip of sheet-iron. This will enable us to make use of these beams like 'summers,' and to unite the joists on their faces, instead of placing them above; and so we shall not have a too great projection under the ceilings. Thus (Fig. 51), having two pieces *A* of 15 c. × 30 c., we interpose a sheet-iron strip *B* of 0.003 m. in thickness. We will bolt the whole together at intervals, as shown at *D*, and we will put the ends of the joists *E* in the holes *C*. Some iron plat bands shall be nailed to unite these ends to

each other, and we shall thus obtain perfectly rigid floorings. Corbels will relieve the span of the beams, which will only enter the walls to a distance of 15 centimetres. There is still a detail to prepare for the carpenter. You must see to it that the ends of the beams fixed in the masonry shall be laid on with red-lead, and that they shall be shut in a box of zinc, No. 14, to prevent the moisture of the walls from penetrating the fibre of the wood. There is your task marked out; put it in shape, and to-morrow, when I have looked over your drawings, we will send for Jean Godard, and choose the wood in the reserve cut by your father."

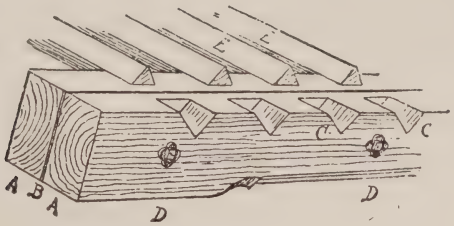


FIG. 51.

The next day Paul produced his drawings. They needed many corrections, but the cousin was able to compliment him on his improvement. Paul took a good deal of trouble, tried hard to understand; and if he did not always discover the most simple and natural solutions, at least he showed that he stopped to think before putting anything down upon paper.

Jean Godard was summoned and the drawings shown to him: some explanations were made to him, after which the cousin asked him if he had any remarks to make. Jean Godard scratched his ear, and said nothing.

"Is there not something you don't quite understand, or that appears defective to you?" asked the cousin.

"No, Monsieur Architect; but, if it's all the same to you, these floorings are not according to ordinary usage; this will be difficult — we are not accustomed — and you see — this is not ordinary carpentry work."

"That is, it will be more expensive than floorings made after your method?"

"Dame! — you see there is workmanship all the same, — all this wood here — must be sawed — perhaps planed too."

"Examine it well, Jean. The joists must be sawed on two sides only, those which are visible; whereas, ordinary joists are taken in sawings. If we asked you to furnish the wood, you might pretend that you would not find joists so disposed; but we must take the wood we have on hand. If it is unhewn timber, it will be sufficient to saw two faces, thus (Fig. 52); it will not matter if you leave the faces *A* roughly squared, and only purged of the sap-wood. If you take your joists from large timbers (Fig. 53), you will only have to saw them as I trace at *B*. But I prefer to take unhewn timber, because it does not 'draw at the core,' as that does, necessarily, which is sawed in four; and I

think we shall have enough of the first so as not to have to employ this means. We shall only have to pay you, then, for the sawing of two faces, as we do for the joists which you ordinarily use. As for the beams, they also will only be sawed on two faces; for if we take them in a single piece, we shall put the two sawed faces outside (Fig. 54), and the strip of sheet-iron being interposed at *D*, below, we will add the moulded plank *C* to mark the junction and the flaws, if there are any. As for the triangular notches

Fig. 52.

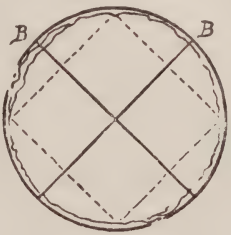


Fig. 53.

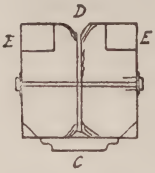


Fig. 54.

at *E*, they are less difficult to fashion than mortises, and the joists, being placed in breadth, have no tenons. It is the same with the summers which receive the ends of the joists along the walls, and replace the cornices. Well, what say you?"

"Dame! It 's none the more the customary flooring!"

"What of that, if it gives you no more trouble to establish? We will keep account of the time you use, and we furnish the wood; you are therefore sure of losing nothing. Think it over, and, if you will, we can make a bargain.

We will pay you by the cubic metre, as for ordinary floorings, or else we will keep account of the time employed in the workmanship, and will pay you according to it. Choose!"

Jean Godard for a long time turned his cap over and over, looked at the sheets of paper spread about, scratched violently his right ear, then his left, and after a good half-hour declared that he would be paid for these floorings as for ordinary ones, by the cubic metre worked.

"And you are right," said the cousin; "for if you manage your work well, and make no mistakes, you will gain more by this bargain than if we paid you by time; for the reason that there is less workmanship in establishing this kind of flooring, of equal cube, than those which you are in the habit of putting down; above all, in this part of the country."

Jean Godard asked that extra pay should be given him for the summers intended to replace the rough fastenings in the walls.

"Agreed," said the cousin. "We economize in plaster cornices, and it is right that we should take account of it in your favor."

It was then decided that the summers should be paid for separately, that is, their notches and chamfers.

On the morrow four saws were in motion cutting up the wood in reserve. The work-yard had resumed all its activity. There remained, for the masonry, a detail of dormer-

windows to finish, which was soon done, and then the passage of the chimney-shafts.

The cousin, in giving Paul the details of the dormer-windows, section *A* and exterior face *B* (Fig. 55), called his

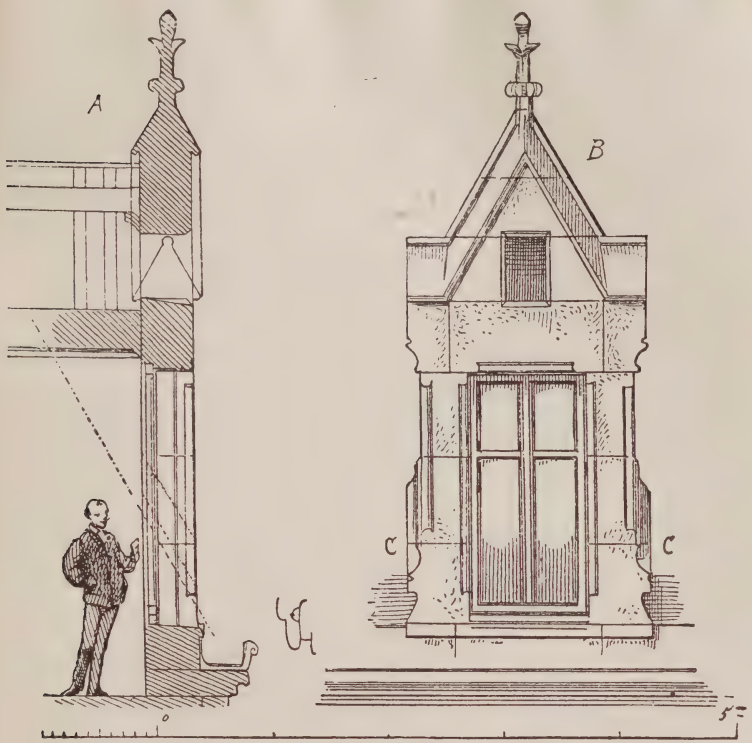


FIG. 55.

attention to their construction. Mounted on a coping 50 c. in thickness, they would compose two piers of three courses each. The first two courses would preserve a fillet *C*, intended to cover over the slating of the covering, and to form

"solins." The lintel and two stones making corbels would come on these two jambs. Two pieces, on this lintel, would receive the little lateral gables, and would compose the jambs of the upper opening, intended to admit air to the attics. The crowning would be made in two courses, with flowers of termination. The section indicated how the glacis of the coping would form solins on the small roofs of the dormer-windows in the rear, and "snuffers" in front, to prevent the rain-water from running along the facings.

CHAPTER XXII.

THE CHIMNEYS.

"WHY," asked Paul of the cousin, "do chimneys smoke?"

"You mean," replied he, "why do *some* chimneys smoke? Many causes contribute to make chimneys smoke, whilst there is only one condition under which they do not smoke. We must try to fulfil this condition. This is it: smoke-shaft in proportion to the fireplace, and the feeding of the latter by a quantity of air proportioned to the combustion. If the shaft is too narrow for the quantity of smoke produced by the combustion, the smoke does not rise easily enough, its upward course is made slow by the friction, and the delivery being insufficient for the production, the smoke overflows outside the chimney. The acceleration of the combustion is followed by the elevation of the smoke by a current of exterior air which strikes the wood or coal. The fire, being well lighted, heats the column of air which fills the chimney, and the more this air is heated, the lighter it is, and the more it tends to rise.

"So it is that, in many badly built chimneys, a certain time

is necessary for the smoke to take its course; that is, it is necessary for the column of air to become heated; and while waiting for it to become so, the smoke passes, not up the shaft, but into the room. Then a window is opened to feed the fireplace with air, the latter lights up, warms the shaft, and the smoke takes its course. This is also why all new chimneys smoke. The shafts, made of masonry, are damp and cold, and the air they contain is heavy; time is needed to lighten and penetrate it with caloric.

"Instead of opening a window to accelerate the fire (which is a tolerably primitive method), a ventilator is established for each fireplace; that is, a channel is supplied to it, by which the exterior air comes in and strikes the fuel as soon as the least heat develops itself, like that, for instance, of a piece of lighted paper. This exterior air at once presses in to fill the void which the beginning of combustion produces, and accelerates the fire by bringing in oxygen. The more the fire increases, the more rapid is the current of air; the more rapidly the air comes in, the more vigorously the wood or coal burns. The ventilator is to a chimney what the bellows are to a forge. But the ventilator must be none the less in connection with the fireplace, as well as the smoke-flue. If the smoke-flue is too narrow, there is an obstruction of the smoke, and it overflows. If it is too wide, it does not become heated equally, for then the currents of exterior air and the wind exercise a pressure, at its exterior orifice, which neutralizes

the action of draught; the smoke is kept down. If the ventilator is too narrow for the extent of the fireplace, it does not bring in the quantity of air necessary for the combustion; the fire languishes, it heats incompletely, and the tepid smoke does not ascend quickly enough. If the ventilator is too big, it either brings in too large a volume of air, the oxygen of which is not completely used, in which case a part of the cold air passes into the smoke-flue and does not accelerate the draught; or else, if there are changes of temperature, the ventilator draws off the air of the chimney, instead of bringing in air from without. There is a reversing, and the chimney smokes horribly."

The cousin explained this theory in the evening, when the family were gathered around the hearth.

"It seems very simple," said Madame de Gandelau; "but why, then, does the chimney in my room smoke some days, though I have often had it repaired?"

"Because your room, Madame, is situated in the new wing of the house, the roofs of which are lower than those of the old building. The smoke-flue could not be raised high enough to pass above the ridges of the old building, for this isolated chimney would not have resisted the squalls of wind. When the wind comes from your side, it finds an obstacle opposed to it by the higher structure, and rebounds; there is an eddy, and, in whirling round itself, it is ingulfed in your chimney, or at least forms an obstacle, at times, to

the passage of the smoke. In this case the shafts should be bifurcated; the pressure of the wind not being ever equal on the two orifices, the air, being ingulfed in one, would make the smoke pass violently out of the other. I know of no other method; I have already proposed it to you; but you have found, not without reason, that these shafts, which seem to raise two desperate arms toward the sky, would be very ugly, and you have resigned yourself to be smoked out, when a sharp squall blows from the west."

"The chimney-man has, however, placed a sheet-iron shaft, with a turning hat, — what he calls, I believe, a 'revolving chimney-top'; he said that this would do nicely, but it is only worse than before."

"No doubt; when there is an eddy of wind, and whirlwinds, in consequence of an obstacle, as is the case here, this revolving chimney-top is agitated, turns this way and that, and in its sudden movements sometimes presents its mouth, if but for a moment, to the squall. This mouth then fulfils the office of a funnel, and the air, plunging into the shaft, sends back the smoke in puffs to the middle of the room."

"That is so; you think, then, that I must accept the two horrid shafts?"

"Assuredly. There are towns in mountain districts all the houses of which, of no matter what height, are subjected to these conditions. Geneva, for instance, built between

the Salève and the Jura, is dominated, though at a great distance, by those mountains. The violent winds which sometimes blow over the lake are ingulfed between the two ranges, leap up, and cause squalls everywhere; and so the Genevans are forced to crown their chimneys with double shafts, which from afar present the aspect of a forest of old-fashioned telegraph-poles."

"I hope you will put chimneys into the new house which will not smoke. You know that Marie would be very much annoyed if they did."

"We shall do so: first, the local conditions are good; we are not subject to, and have not to fear, eddies of wind; the breezes are regular along the plateau on which we are building; then we have only simple, high coverings, and all the chimney-shafts pass above the ridges. We will establish these shafts with brick, with good sections. Nothing obliges us to deviate them materially; they rise vertically, or nearly so.

"Then we will establish a system of ventilators in the subsoil for cool air; for we must pay attention to this, that when the ventilators, for instance, are opened at midday, it happens that the air they receive from without, even in the winter, is warmer than that of the room where a fire is lighted; then the ventilator draws the smoke, which falls back into the room. The fire can scarcely be lighted; the wood blackens, and does not burn.

"A single smoke-flue is used a great deal now at Paris

for several fireplaces, placed one above the other, and, parallel-wise, a ventilation-shaft, which carries a branch to each of these fireplaces. This is especially good in houses where as many as five fireplaces are placed one above another, for thus the weakening of the walls by reason of too many chimneys in juxtaposition is avoided. The fireplaces draw reciprocally, and this system withdraws the smoke from the rooms. These chimneys must have a section proportioned to all the fireplaces; that is, they must have, for five ordinary successive fireplaces, a section of 16 superficial centimetres, and a square of 40 c. each side. But here, where we only have three stories, I prefer to have special chimneys for each fireplace; inasmuch as in the case of a single chimney it is necessary that they should all have fires, which is always the case in a large town. In default of this, the smoke, in a sudden change of temperature, would pass into an upper or lower fireplace, instead of following the vertical column. This inconvenience, which is an accidental one only, is remedied by well-set traps."

"But," said Paul, "will not the cold air of the ventilators cool the rooms?"

"The cold air comes into the fireplace, but not into the room. It is clear that if a fire is not made, this ventilator provides cold air, which tends to lower the temperature of a room; it can be shut out by a trap. But remember this, that to make a fire, to burn wood, coal, or what not, you

must have oxygen; you have learned this in your study of chemistry and physics; then, you must have air; without air, no fire. Formerly people did not take the trouble to establish ventilators for fireplaces, as the air penetrated to the rooms under the doors, by ill-closed windows, and also because the rooms, being very large, contained a cube of air considerable enough to feed the fire for a long time. The chimneys of our ancestors, let me add, smoked somewhat. Nowadays we are more delicate; we want smaller rooms, well shut in, and we shrink from the currents of air; but the chimney requires air, without which its fuel would not burn, and warm you. It is clear that this column of cold air, which you call in to accelerate combustion, carries off with it, in rising in the smoke-flue, not a little of the heat. Several systems have, therefore, been invented to prevent this heated air from passing off too rapidly. It has been turned in the shafts, and forced to remain as long as possible, or at least to leave a part of the heat which it has absorbed in the numerous corridors through which it passes. These corridors in their turn heat a cavity, a chamber which opens on them, and which is also fed with air. This air, expanded by the heat, tends to waste itself. Issues for it are opened, which are the mouths of heat. This is the principle of hot-air stoves."

"Apropos of hot-air stoves," said Madame de Gandelau, "do you propose to put one in the new house?"

"Certainly; its location is designated in the plan of the cellars under the hall; and its flue passes in the interior angle of the main staircase. Such a stove is indispensable in a country-house, especially when it is not occupied the whole winter. It is the means of avoiding numerous deteriorations. It suffices, during the cold and wet season, to heat the interior, and so keep it dry, once or twice a week."

"Don't you think hot-air stove-heat unhealthy?"

"The hot air emitted by the hot-air stoves is unhealthy, because in being heated it loses a part of its oxygen, and oxygen is as necessary to life as it is to make fuel burn. A part of the accidents caused, in the animal economy, by air deprived of oxygen, is avoided, by making it pass, at the exit of the receiver of the heat, over basins full of water; but this means is only a palliative one, and a part of the heat is thus lost. I only regard hot-air stoves as good for heating places which are not constantly used, such as halls, staircases, galleries; but if registers are established in the drawing-rooms, dining-rooms, and bedrooms, they should not be opened when those apartments are occupied. They must only be opened to dry the interiors when you are away; and the windows should afterward be opened, and the registers shut when you shut the windows."

"How would you heat the bath-rooms?"

"By means of a boiler placed near the hot-air stove, with

columns of ascent to the bath-room on the first floor, which are nearly over the fireplace."

"You have also planned bath-rooms for the domestics."

"Yes, underneath the bake-house and wash-house, under ground."

"I perceive that you have foreseen everything. This is a conversation about chimneys, Paul, which you will do well to take good note of."

"I shall certainly do so, mother."

CHAPTER XXIII.

THE CANTEEN.

DESPITE recent disasters, life seemed to be returning as if by enchantment to the cities and country. Everywhere work was being resumed, to make up for lost time. If the uneffaceable memory of the misfortunes which seemed to have drained all the resources of France was still preserved, a patriotic instinct inspired redoubled efforts to repair so much ruin, without giving up to vain complaints. Those who passed through France during February and March, 1870, might have compared the country to one of those ant-hills which some awkward person has overturned with his feet. The ants do not waste their time in imploring Providence; they set forthwith to work, and if you go by the next day, all traces of the catastrophe which seemed to have destroyed the colony has disappeared.

But late in March the papers brought news of the fresh disasters to Paris. M. de Gandelau had thought of sending his son back to the lyceum. Although Paul was by no means wasting his time, it seemed a pity to interrupt any longer

his classical studies. The latest news did not, however, permit M. de Gandelau to hesitate. Paul continued to work with his cousin, who, for his part, decided to remain at the château awaiting events.

M. de Gandelau, loved and respected by all the vicinity, had no anxieties on his own account. Some ill-looking fellows had made their appearance in the neighboring villages, but they found nothing to occupy them, and soon disappeared. Papa Branchu and Jean Godard had come to the château to tell M. de Gandelau that the workmen begged of him not to suspend the works, and that they were ready, if money were wanting, to await more prosperous days for their pay. They only asked, for the time being, soup and bread. M. de Gandelau, having made great sacrifices during the war, could not now avail himself of sums sufficient to pay the regular wages demanded by the activity employed on the works; and it was decided to establish a "canteen" near the work-yard, where M. de Gandelau should furnish flour, wood, meat twice a week, vegetables, and lard, and each workman should receive as many portions as himself and family needed for sustenance. Each portion was valued at a fixed price, and the rest was to be paid in money later on, according to the definitely established rolls. Half a dozen workmen, strangers to the district, did not accept this arrangement, and quitted the work-yard. The others, having full confidence in M. de Gandelau's loyalty, subscribed to the bargain, the more

readily as they foresaw the results of a forced economy in a saving. Paul was intrusted with this new detail, and to his functions as inspector were added those of a purveyor. His cousin showed him how to keep the accounts, so that all interests should be protected.

Proud of this new trust, he acquitted himself of it well. He rose at five in the morning, mounted his pony, and hastened from the château to the mill, from the mill to the village, and from the village to the work-yard; every evening he rendered to his father an account of the deliveries of the day, and to his cousin the calculations made on the ground.

This existence strengthened his body; the responsibility with which he was charged matured his mind. Towards the end of May the young collegian, who had had nothing to do in August, would hardly have been recognized in the robust, serious, attentive youth he had become.

One morning the cousin said to him,—

"You must go to Chateauroux, as we have no joiners here able to execute our works. I will give you a note to a good master-joiner living there, and you will come to an understanding with him. But first we must get our details ready."

CHAPTER XXIV.

JOINERY.

"EVERY detail of the joinery," said the cousin, "should be given before beginning the construction of a house; for the first condition of joinery work is to choose the woods, and to only use those which are thoroughly dry, and have been cut several years. We have been short for time, and have not been able to attend to this important part of our construction. Fortunately I know a joiner at Chateauroux, who has wood in stock, of which he is avaricious, and only uses sparingly; I will persuade him to furnish us with some. Your father has done him some favors; and I presume he will make no difficulty in letting us have some of the dry and good woods which he has reserved for special occasions.

"But if it is indispensable, in joinery work, to use only dry woods, without defects, it is equally so to combine this sort of work in accordance with the nature of the materials, and not neglect the conditions they impose. Wood is cut according to certain customary dimensions, and to the size of the tree. Thus, for instance, a plank is only from 20 c. to

25 c. in width, because trees proper for joinery have scarcely more diameter than this, deducting the sap-wood; then, if panels are made, it is prudent to give them only a width of 20 to 25c., that they may be taken in a plank. If two or three planks are brought together to make a panel, they will separate after getting dry, and will leave cracks between them; while in giving to each panel the width only of a single plank, if the latter makes a shrinkage, this shrinkage will be produced in the tongue, and there will be no separation. These tongues, however, must be large enough to bear a shrinkage without passing beyond the rebate. You will understand this better presently.

"In the last century many doors were made with large frames, that is, with the panels, framed by mouldings, having a width of 40 to 50 c.; that was the fashion. But at that time only very dry woods, cut for many years, were used; and the panels, made of two planks brought together, or simply joined, did not suffer shrinkage. You can see doors so made in your father's drawing-room, and there is not one on which the panel is open. Now, such wood cannot be had for money; we must, therefore, do the best we can, and give up large panels. Or, if they must be had, they must be taken in white-wood, a sort of poplar, because this wood dries quickly, and does not bend across the fibre. But this is a tender wood, easily eaten by worms, especially in the country. Let us, then, stick to oak,

and so combine our doors that the panels shall only have a width of about 20 c. There are doors of one leaf and doors of two leaves. The latter are 1 m. 20 c. in width; the former, 80 c. to 1 m. Their height varies from 2 m. 10 c. to 2 m. 20 c.; it is useless to give them more, for we do not walk into rooms with crosses and banners, and the human form seldom exceeds 1 m. 80 c. Too high doors have many inconveniences. They are liable to warp, they are difficult to shut, and, if it is cold, every time they are opened they admit a large cube of moist and freezing air, which cools the occupied rooms.

"Let us begin by tracing a door with two leaves. We will make the frames and cross-pieces of wood 4 c. thick. 'Stocks' are the framing-pieces; rabbets or leaves, the pieces *A* (Fig. 56); the cross-pieces, the horizontal intermediate pieces; each post will be 11 c. wide, the small intermediate posts, 5 c. Each folding leaf, deducting 15 m. for the middle rebate, will therefore be 0.595 m., as the door will have a width of 1 m. 20 c.; deducting 0.11 + 0.05 + 0.095 m. for the three posts (total 0.255), there remains for the two panels 34 c., and for each of them 17 c. The cross-piece must be placed so that its axis shall be 1 m.

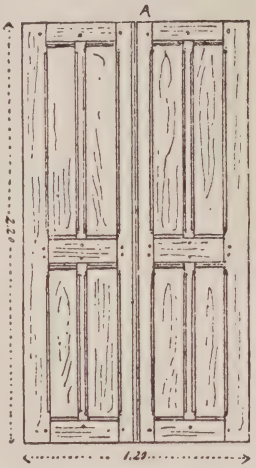


FIG. 56.

above the floor; for the lock is placed on this cross-piece, and it is necessary to give the cross-piece 15 c. in width, so that, deduction being made of the mouldings, there still remains 10 c. for the lock, the box of which is usually 8 to 10 c. in width. This sort of doors is called 'with glass panels'; all the parts being made in square, without joints, and the panels being narrow, the doors do not get loose, and maintain themselves perfectly.

"Let us consider the door in its details (Fig. 57). Let *A* be the jamb, in masonry, of the opening; a sleeper *B* is fastened to this jamb. On this is fixed, with screws, the hinge-plate *C*, on which the leaves turn; *D* is the 'stock'; *E E* the folds; *F* the intermediate post; *G* the panels with their spliced tongues. The door-cases *H* form rebate around the stock. The mouldings *I* are carried along the rebate of the folds, intended to give this rebate more resistance, and present a rounding which will not grate on the hands or fray the clothing. At *K*, you see the high cross-piece, with its tenon *L*, entering a mortise at *M*, which will cross the fold. On the right of the junction of the intermediate post *N*, the moulding *O* is cut square to permit the head of this post to pass, its tenon *P* entering a mortise at *R*. At *S*, you see the rebates in which the panel tongues *T* are spliced, the panels being reinforced at a certain distance by these tongues as you see at *V*, so that their thickness shall be 0.022 m. You will observe that the chamfers of the posts *X* stop below the

junctions to leave to the wood all its force on the right of the junctions. For doors of this size, we must have three hinge-plates to each leaf.

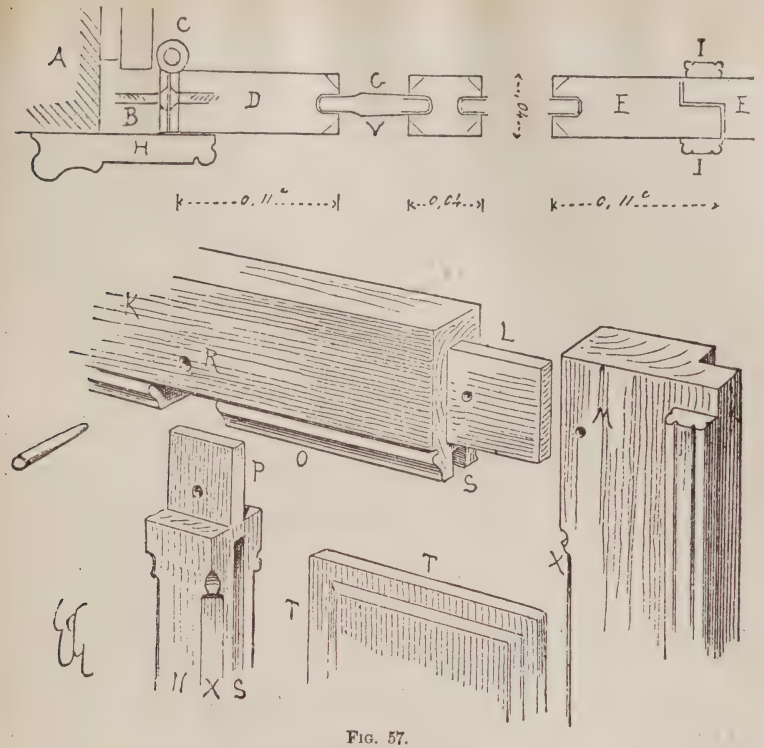


FIG. 57.

"This gives you the key to the whole joining of the ordinary and well-made door. The rule is simple; never weaken the wood on the right of the junctions, always make these in square, and do not exceed the dimensions given by the cut wood.

"Our single-leafed doors shall be established after this system. It remains to consider the window casements. We

will follow the same principle, avoiding defective joinings, and making them all in square. Here is one of these casements (Fig. 58), composed of a sleeper *A* fixed in the rebate of masonry *B*, and of a frame with two leaves. The thickness of the wood of this frame shall be .04 c., and the posts of the leaves shall be united with round rebate and groove. To avoid putting in glass of too large a size, or the necessity of putting in glass, we will divide the leaves by a small piece *C*. The details of these casement-frames must be explained; they are represented by Fig. 59.

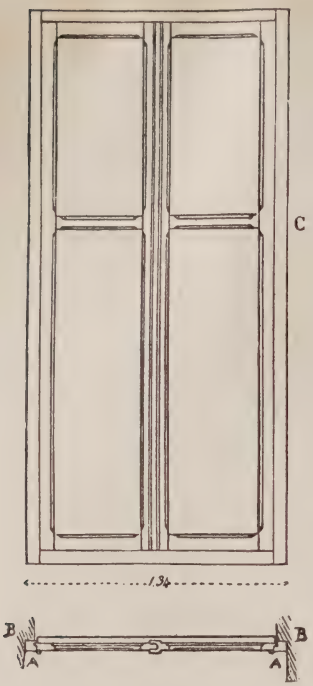


Fig. 58.

"At *A* I have marked the rebate of the plane of the window; at *B*, the sleeper; at *C*, one of the posts, which enters the sleeper by a tongue, to arrest the passage of the air; at *D*, the post of the rabbet ledge, with its round rebate and groove, and the rabbet *E* on the left. The fastening is placed on the strengthening-piece *F*. The profile of the cross-piece of the sleeper is shown at *G*, and at *H*, of the lower cross-piece of the casement-frames, with its weather-rail to prevent the rain or snow from penetrating the interior.

"But as it happens that, despite these precautions, the rain, when violently dashed by the wind, reaches the rebate and the interior, a little canal *a* must be fixed in the rebate, so that the rain may not spread over the internal side of the

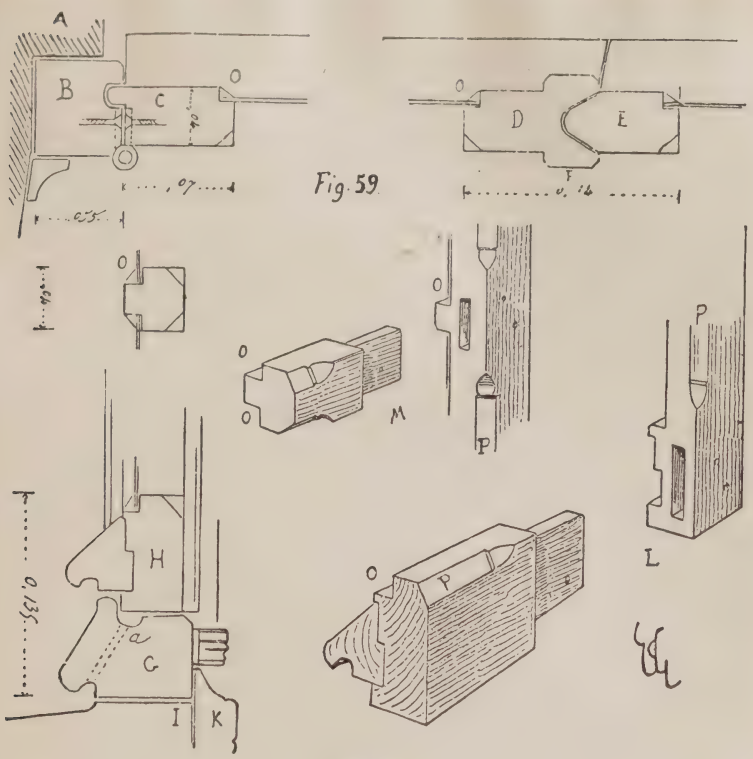


Fig. 59.

FIG. 59.

wall *I*. In order to mask the junction of the supporting wood cross-piece with the stone support, we will put the cyma *K*. At *L* you see the combination of the lower cross-piece with the post, and at *M* that of the small wood-piece with the

same post. You will remark the external rebates at *O*, for receiving the glass, and the chamfers *P*, with rests on the interior to leave the combinations with all their force. Besides the three hinge-plates necessary to each leaf, you must count squares notched above and below, to prevent the frames from tiring out the combinations, and from weighing on the middle of the casement; for the glass cannot fulfil the office of door-panels, which stiffen the framework. On the contrary, the glass, by its weight, tends to deform the frames.

"Now, Paul, you will put down these details, and I will correct your tracings; then, armed with these drawings, you will go to Chateauroux, and will submit them to the master-joiner, who will give you his prices for them. You will explain the drawings to him, keeping in mind all I have told you, and you will bring back his terms. I will, besides, give you an introduction to an engineer at Chateauroux, a friend of mine, who will receive you like an old friend, and can complete the information of which you are still in need."

Madame de Gandelau consented to Paul's journey with hesitation; but being assured that the cousin's friend should be apprised of it, and would meet Paul at the station, and that he would sojourn with a family happy to welcome him, she gave her consent.

Paul would only remain three or four days at Chateauroux, which was but twenty-four kilometres away.

CHAPTER XXV.

WHAT PAUL LEARNED AT CHATEAUROUX.

PAUL already knew enough to have some timidity at being intrusted with a task which he saw to be important. It would have been easy to write to the master-joiner to come to the château, but the cousin had asked M. de Gandelau to send Paul to him, in order to put his inspector to the proof, and see how he would manage the affair. The cousin gave him ample instructions, and repeated them several times; and Paul took notes of the important points. He was supplied with plans giving the number of openings, the handles of the doors, the surfaces of the floors, the panellings, the cymas, and so on.

He reached Chateauroux about ten in the morning, and found M. Victorien, the engineer, who was his cousin's friend, awaiting him at the station.

M. Victorien was still a young man, though his closely cut hair was grizzled. A swarthy complexion, clear eye, and aquiline nose gave a certain military air to his countenance, which at once attracted our embryo architect. The cousin's letter had apprised him of the circumstances of the house-

building, and of Paul's visit. He knew M. de Gandelau slightly, and professed a high esteem for his character. He therefore received the youthful traveller as a younger brother. Madame Victorien, a little round and brown woman, who seemed to be her husband's antithesis, he being tall and dry, could not do too much for her guest. When they were at breakfast, Paul had to answer many questions; how his family had felt during the late events, what the new house was, how it was going forward, how many workmen were employed, how the works were managed. Paul answered as best he could, and even ventured to make some sketches, in order to explain to his hosts the situation of the new house and the present stage of its progress.

"Why," said M. Victorien, "I see that you have profited by your cousin's lessons; he is the most skilful designer in explanatory sketches I know."

This compliment encouraged Paul, who related how his education as an architect had proceeded.

"We have all to-morrow in which to go to the joiner; if you will, you shall go with me to the sluice-works in which I am engaged, about two leagues from here. That will perhaps interest you."

Paul eagerly accepted this invitation, though Madame Victorien protested that her youthful guest might be fatigued, and that he ought to have time for rest.

"Come, come," said M. Victorien, "tired — at his age, with

his bearing, and having rested for two hours seated in a wagon? Get us a good dinner against our return at seven o'clock, and you will see if our friend does not do justice to it! Did he not say, too, that he was on his feet five hours every morning, and was running about all day? Come, let's be off!"

A small wagon soon carried the two companions far from the town.

"So," said M. Victorien, when they reached the first hill, "your cousin has not been wearied by his short campaign? I saw him but a moment when he passed through here with his troops. What an energetic man he is! But he does not always take care of himself. How clearly he explains everything; does he not? We have been chums, and he hesitated for some time whether to become an architect or a civil engineer. He was capable of being either."

"What is the difference between an architect and an engineer?"

"The deuce! You ask me a question difficult to answer. Let me give you an apologue. Once upon a time there was a pair of little twins, who were so much alike that their mother could not tell them apart. They had not only the same features, height, walk, but also the same tastes and habits. It was necessary for them to work, for their parents were poor. Both became masons. They grew skilful, and what they did was done equally well by both. The father, who

was narrow-minded, thought that these four hands, which labored at the same work with equal skill, would produce more and better if the work were divided into two pairs of hands. He said, then, to one of them, 'You will only work underground'; and to the other, 'You will only work above ground.' The brothers thought there was little sense in this, as they helped each other in the one case as well as in the other; but, being submissive sons, they obeyed. Still, these workmen, who, up to this time, had agreed, and made mutual efforts in perfecting their work, did not cease from quarrelling from that time. He who worked above the cellars complained that the foundations were not properly cemented, and he who established the foundations said that account was not taken of the conditions of their structure. They finally separated, and each, having become accustomed to the specialty which had been imposed upon him, remained unfit for anything else."

"I think I understand your apologue; but—"

"But it does not explain to you why a distinction is made between an architect and an engineer. In fact, a good engineer can be a good architect, and *vice versa*. Engineers make bridges, canals, port works, and so on; but this does not prevent their building lighthouses, shops, factories, and other constructions. Architects should know how to do all these things; they formerly did so, because then the twin brothers were not separated, or rather they were one and the same person. But since this single individual-

ity has been divided, the two halves go each his way. If the engineers build a bridge, the architects say that it is very ugly, and they are not always wrong. If the architects raise a palace, the engineers exclaim, not without reason, that the materials have been unskilfully employed, without economy, or an exact knowledge of their durable and resisting properties."

"But why do engineers build bridges which the architects think ugly?"

"Because the question of art has been separated from that of science and calculation by this narrow-minded father, who thought that both could not be held in the same brain. The architects have been told, 'You shall be artists: see nothing but form, and busy yourselves only with that.' The engineers have been told, 'You will only occupy yourselves with science; you have nothing to do with form: leave that to the artists who dream with their eyes, and are not capable of reasoning.' This seems strange, I see, to your youthful mind. It is all simply absurd, because the art of architecture is only the consequence of the art of construction; that is, of employing materials according to their qualities or properties, and because the forms of architecture are notoriously derived from this. But, my young friend, as you grow older you will see many other things in our poor country, hampered as it is by routine. Psst! Get up, Coco! The rest of the way is level."

They soon reached the sluice-works. Two coffer-dams, one downwards and the other upwards, barred the watercourse; a large water-spout carried the current over the workmen employed in founding the walls, making a sluice-chamber. Paul was informed of the function of the water-spout, which he soon understood, since he had made them with tubes of feathers and wax, and had thus emptied glasses of water. He had never supposed that this little hydraulic apparatus could have so important a use. He saw how the cement, which was run under the lateral walls of the chamber, was made. A horse was pulling on a large wooden lever which moved an iron tree, pivoting in a vertical cylinder, and which, provided with paddle-boards, mixed up the clay slaked with sand that was introduced at the top of the cylinder. A sluice below let out the mortar, well puddled, into wheelbarrows, which the workmen carried to a plank platform, where it was mixed with a double quantity of pebbles, by means of rakes. Then other workmen carried the well-mixed cement to a hopper, which conducted it to the bottom of the excavation, where still other workmen spread it in layers, and pounded it down by aid of wooden rams. The disposition of the doors, the arch, the threshold on which the leaves were to rest, lined by the sluice, that is, presenting an obtuse angle towards the upper part to resist the action of the current, were also explained to Paul. While supervising his works and giving his orders, M. Victorien ex-

plained to Paul the function of each portion of the work, and the latter took notes and made sketches in his memorandum-book, so as to remember what he saw and heard. This attention on Paul's part seemed to please M. Victorien very much; and when they got into the wagon to return to town, the engineer did not fail to complete his explanations. He described the sluice-gates of seaports, how they were made thirty metres and more in the openings, partly of wood and partly of iron, or entirely of iron, and promised to show him, when they reached the house, sketches of some of these sluices. Then they talked about bridges, and how their piers were founded in the midst of a current.

M. Victorien explained how, by means furnished by modern industry, piers were established in wide, deep, rapid rivers, where this operation had not formerly seemed practicable; how tubes of double sheet-iron were sunk vertically, so that their lower extremity touched the bottom; how, by the aid of powerful machinery, they compressed the air in these enormous hollow columns so as to drive the water out; and how they then established masonry, filling these cylinders, so that perfectly solid, stable piers, able to resist heavy weights, were obtained; and that as the sheet-iron would be destroyed in time, the columns of masonry would remain intact, having had time to assume a perfect consistency.

These explanations opened to Paul a new horizon of study,

and he asked himself if he should ever find time to learn all these things; for M. Victorien kept repeating to him that an architect ought not to be ignorant of these means of construction, because it might happen that he would have to use them. Paul became absorbed in thought. M. Victorien perceived it, and said, —

"Let us talk of something else; you seem to be a little tired."

"Not in the least," returned Paul. "But I have found it difficult to retain in my mind all that my cousin has told me, when the subject was the building of a house; and I thought that when I understood the various things which he explained to me, I should have a summary of all that I had to learn. Now I see that there are many things relating to constructions which it is necessary to learn — and — I declare — "

"And that disturbs and frightens you. Take time. Don't try to learn everything at once; listen attentively, — that 's all. Little by little all this will disentangle and classify itself in your mind. Rest easy; young brains are full of empty drawers. All that we should ask of the young is to open them; each knowledge classifies itself in that to which it belongs. Later on, you have only the trouble of opening the drawer which contains this or that thing, stored away almost unconsciously; it is found intact, ready to be put to its proper use. Only you must always keep all the drawers

open during the gathering of the crop, the time of which is brief. If you leave them shut during early youth, from twelve to twenty-five, it is afterwards a hard task to fill them, for the locks are rusted; or they are filled, you know not how, with trash for which there is no use."

The companions had now reached home, where Madame Victorien had prepared a good supper, cheered by the presence of two boys just from school, who were soon on the best possible terms with Paul.

The next day was devoted to the master-joiner, to whom were explained the details brought by Paul, and with whom the bargain was discussed, in which Paul was assisted by M. Victorien. Paul had been well trained by his cousin, and fulfilled his mission with great success; and was much flattered when, after the conference was over, M. Victorien began to call him "Monsieur the inspector," and gave him all sorts of technical explanations, which Paul failed to comprehend, reserving it to his cousin to give him the needed enlightenment.

Some curious buildings in the environs were visited the next morning, and at nine in the evening Paul returned to the château, his valise full of notes of what M. Victorien had told him about bridges, sluices, the materials of the country, and the way in which they were used.

CHAPTER XXVI.

THE ROOFING AND PLUMBING.

ALTHOUGH Paul might have returned to school at Paris in June, Madame de Gandelau, being fearful of typhus fever, insisted that her son should remain at home. The tranquillity of the capital was not yet assured. A teacher in the neighborhood, a man of more learning than public-school teachers usually are, came every day to instruct Paul for an hour or two, that he might not forget his Latin; and the rest of the time was devoted to the supervision of the works, which were now visibly progressing. The walls were raised, the floorings set, and the carpentry of the roofing was being erected; and though there were no more details to be supplied to the workmen, the supervision had to be the more minute, as the cousin permitted nothing to be lost sight of, and required that an account of everything should be submitted to him. Sometimes, when Paul returned from the work-yard, the cousin asked him if he had seen this or that part; and if Paul hesitated, said, —

"Well, my friend, you must go back and see it, and give me an account of it; not to-morrow, but at once." Paul thereupon mounted his pony and returned.

He thus acquired the habit, in order to avoid these monotonous goings and comings, to return only after he had examined every point which could provoke a question from his cousin, in detail. The latter had called Paul's special attention to the grapplings. He asked him several times how the cramps were placed; and if the explanations were not satisfactory, he had to return to the work-yard, and could not leave it until they were placed in presence of the inspector, as had been enjoined upon him. The visits with Paul to the work-yard occurred three times a week, and instructions were given before him, on the spot, to the contractors. The cousin was always careful to make Paul repeat these instructions, to be sure that they were understood.

It was time to consider the gutters, the draining of the rain-water, and the roofings.

"The roofings," said the cousin, "are generally ill done in country-houses, especially the plumbing work, and we shall have to be very careful in this important part of our building; for a house badly roofed is a man incompletely or badly attired. Both acquire incurable diseases. Here we have no good plumbers, and some must be got from Paris, which will cost dear; but in the end this is economical, since we shall avoid incessant repairs and irreparable bad work. We will adopt a covering of clasped slating.

"Usually slating is fastened with nails on a scantling of spruce, or white-wood; but in order to fasten the nails in the

scantling the slating must be pierced by two holes, since each is held by two nails. The slating shakes by the blowing of the wind, the holes become enlarged, and finally escape from the nail-heads; and then the slating falls. You must take up several slates in order to replace one, and the last must necessarily be pierced with nails on the visible part of the slate. With clasps, this inconvenience is avoided, and the repairs can be made by anybody. These clasps are made of red copper, which enables you to open and shut them more than five-and-twenty times without breaking them. Besides, the slating, being held on its lower part, does not shake by the action of the wind, and no effort can disturb it. In the ordinary system of slate covering there are three thicknesses of these plates, one upon the other. The uncovered part being 11 c., the slates are 33 c. long. To place clasped slating, laths are nailed on the rafters in the place of scantling, spaced one from another 11 c from axis to axis (Fig. 60). You see at *A* the position of the laths and of each slate. The clasps pass in the interval left between the slates, and seize the extremities of each. I show you in a section, at *B*, half of the execution, the laths *C* nailed to the rafters, and the clasp, the point of which is fastened in the lath, with its return *E* holding the uncovered part of the slating. This will do for the breadth, but not for the returns, arris, and gutter-leads. When there are arris and gutter-leads, the slatings not being flexible, lead or zinc must be used; the first of these metals is much the

best on wood, as being less subject to break or change. As for the arris, they are fastened by plates of lead folded on the wood, replacing the slating and overlappings by the lath; as for the gutter-leads, a plate of lead is extended in the entering angle, on which, on the two sides, the slating is brought. But you will study the many details of the roofing when the workmen are at the task, for this sort of work requires minute care; you have to contend against a subtle enemy, — water. Water seeks all issues, profits by every negligence to invade a house; and when urged by the wind, acquires a force and an activity which it does not have when it falls vertically.

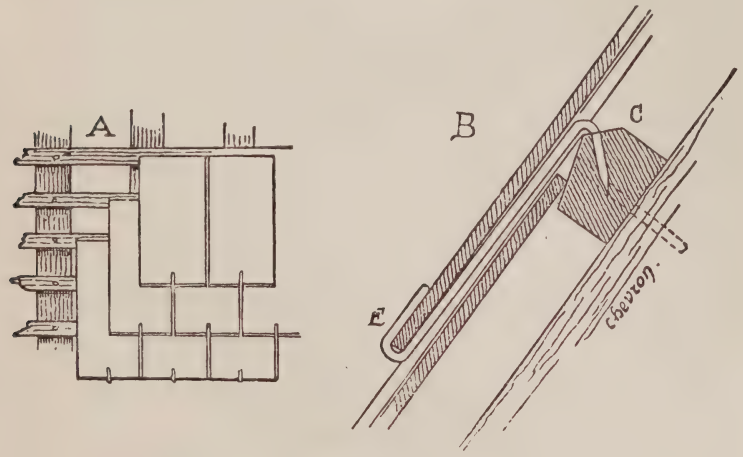


Fig. 60.

"So in climates where the showers are gentle, and only fall in calm times, the roofings are simple, and do not require the numerous precautions which are necessary here; and that is

why I adopt the system of clasped slatings. Here, the north and northwest winds are violent, and bend the rain and snow to an angle of 30 degrees. Slating which is only held at the top yawns, and rises up at the bottom; and the rain and snow get in. This is why we have given our roofings an angle of 60 degrees; for the rain, violently pushed, usually comes perpendicularly upon this inclination, and does not penetrate underneath the slating.

"The gutters also require great care. Their bottom must have a sufficient inclination, say of 3 c. per metre, to allow of the running off of the water; but there must be a projection, a small step of 4 to 5 c., at each plate of metal, whether lead or zinc, which forms the canal, so that the water shall not penetrate beneath the joinings. These necessities demand a sufficient depth for the gutters, so that these inclinations of the culminating points shall be at the falls or shafts of descent, and that these shafts shall not be too distant from each other, so that the water should not have to travel far. Moreover, issues or small gargoyles should be arranged on the external facing of the gutters, so that if the snow or ice blocks up the orifices of the shafts, the water shall find a place to run down. It is prudent, besides, to give to the internal reverse of the gutter a greater height than the outer border, so that the water shall in no case penetrate to the interior. Here (Fig. 61) is the profile which we will give to our gutters. The coping *A* having a height of 40 c., the plank forming the outer border

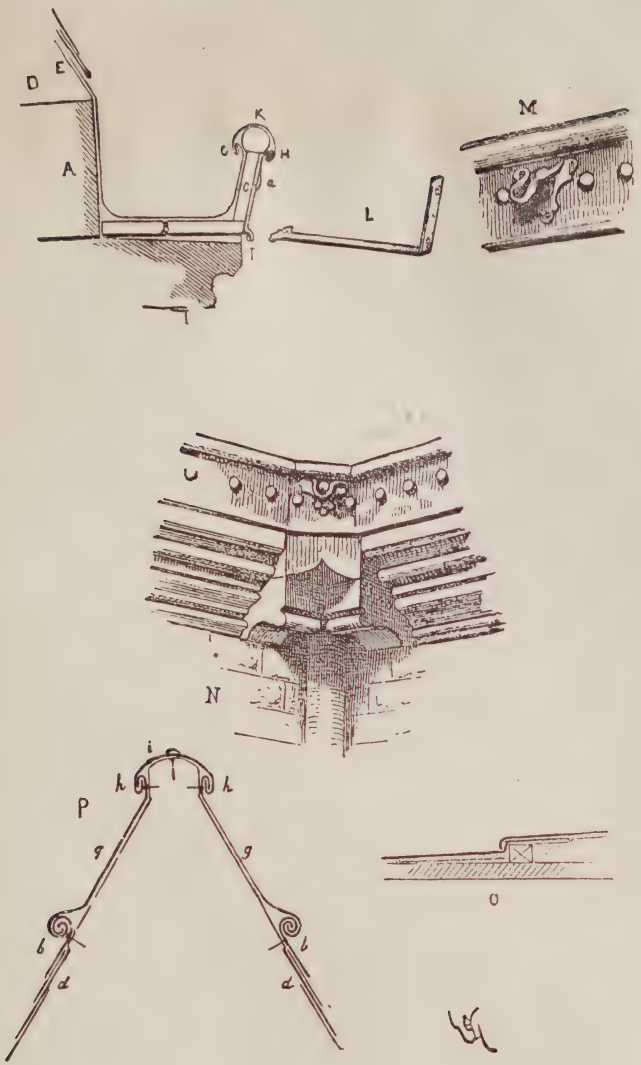


Fig. 61. — PLUMBING OF THE ROOF. — Page 256.

of the gutter will be 33 c. You remember that on the shelf of the cornice we have a slope, making a void between each junction, to ventilate the under side of the gutter, and facilitate the running off of the water, should there be a leakage. Our gutter, then, will be composed of an oaken plank *B*, forming a bottom; of a border *C*, forming the face; and of a 'bead' on the opening of the border. This plank will be slightly inclined, so that the lead of the gutter shall tend the less to settle.

"The fall of the roof being at *D*, our lead-plates shall be fixed, by aid of nails, at *E*, shall follow the section of the canal, and shall turn at *G*, forming a hook. We will place on the face another lead-plate, which will form the same hook at *H*, then at *I*, with zinc hooks nailed to the plank. These plates shall be maintained on the face by screws, the heads of which will be masked by the soldered protuberances *a*; then a bead, *K*, will be placed between the two hooks *G* and *H*.

"Previously the bottoms and external borders of the gutters will be united by notched iron squares, *L*, which shall be fixed at the base of the coping. These shall be placed outside of, and not within, the gutters. We will pierce the holes to receive the little gargoyles *M*, from distance to distance on the face of the gutter.

"The shafts or funnels of descent placed in the re-entering angles of the building will join their upper orifice in a space made in the cornice, as is shown at *N*. A leaden 'muff'

will unite the bottom of the gutter with this orifice, and will only be soldered to the bottom of the gutter, remaining free in the part penetrating the funnel. To obtain the necessary inclinations in the bottom of the gutter, 'dubbings out' of plaster, with supports for the projections, shall be established on the right of each plate, as you see at *O*. These plates should not exceed a length of three metres each.

"The ridges of the roofing and the dormer-windows shall be in the same way established in lead, and hooked as shown at *P*. Two leaden strips *b* are nailed, covering the slating *d*; then the free parts of these strips are rolled with leaden leaves *g*, which themselves become hooked at *h* with the plate *i* which covers the ridge. The lath is, besides, held by screws the heads of which are masked by a piece of lead; thus it cannot be stirred by the wind.

"I am only indicating to you the principal points in plumbing work, which is very delicate and requires great care. You will study this minutely when the work is being done, when we shall have good workmen employed on it. The Parisian plumbers are remarkably skilful. They also establish the distribution of water in houses, the water-closets, baths, and so on. But let me give you this important piece of advice. Plumbing put upon unfloated oak becomes oxidized very rapidly. The acetic acid contained in this wood changes the lead placed on it to a state of white lead in a few months, especially if the wood is not ventilated on the opposite side.

I will point out the woods which must alone be used for the gutters and other lead work. We will take old wood from the ruins of the old mill, which when cut up will be in the proper condition, since it has long since shed its sap.

"Your duties as inspector will, above all, consist, when the plumbers set to work, in carefully weighing the metals brought, and having the clippings stored in your presence. These men, skilful in their workmanship, work rather too artistically, and readily neglect material interests: they let the lead and tin lie about everywhere in the work-yard. You see that we must not expose our country lads to temptations. You must, then, weigh the metals on their arrival, and then the clippings. The latter should be stored and securely shut up. The difference between the weight of the metals when they arrive, and that of the clippings, shows what has been used, and what is due, as the plumbing is paid for by weight. The agreement with the joiner which you have brought indicates that the floors, doors, and windows should be sent before the end of August, I think."

"Yes; and the contractor said that the floors should be begun to be set by the 1st of August."

"It is too soon; we must let the building dry a little. This contractor is pretty active; if he begins on the 1st of September, he will have finished by the 1st of October; then we will set the painters to work, and by the 1st of December our house may be regarded as finished. We must also think of the

marble-cutter, and order the mantels for the fireplaces. It is by no means too soon. Did you give the joiner the dimensions of the fireplaces?"

"Yes, they are marked on the plans."

"Well, make duplicates of the plans, and we will send them to the marble-cutter. We must deal, for this, with a Paris house; it will be cheaper, and we shall have a wider choice. Is is very awkward to have to run to Paris every day, as we have to do now, for a hundred details of a construction. But, excepting in such centres as Lyons, Tours, Bordeaux, Rouen, Nantes, and Marseilles, where well-supplied houses are to be found, there is nothing in the provinces. It was not so formerly; it is one of the fruits of our system of extreme centralization.

"I do all I can to resist this unhappy tendency; but when one is in a hurry, he must necessarily resort to the great centres of the building industry. We should have to wait six months and pay higher prices, to get our chimney-mantels at Chateauroux or even at Tours. The contractor to whom we applied would resort to Paris, and we might as well do that ourselves. As for the greenhouse on the garden, and the marquee at the entrance, we may rely upon our locksmith, who is an intelligent workman. The country carpenters and locksmiths are usually good."

"Why is that?"

"Because the carpenters have preserved their corporate

organizations, or at least something equivalent to them, and tests are required before they can enter them. The locksmiths in the country have kept up the use of the forge; and the forge is the whole of iron-work. In the large towns, on the other hand, they have been taken with a rage for casting and founding, and workmen on buildings have become unaccustomed to the minute work of the forge. They are no longer anything but adjusters. Still, there has been a reaction during the past few years; and you might have seen, at the Exposition of 1867, finely executed pieces of forge-work. But architects also have become unaccustomed to this sort of work, and have little knowledge of how iron is worked with the hammer, and how soldering is done; they give their contractors details impossible to execute, or which impose many difficulties upon them. Architects ought to know the methods of fabrication in each industry they employ, but they are not taught these things at the School of Fine Arts. It is thought better to show them that matter is made to obey all the fancies of the artist; this gets rid of explanations, and makes instruction a more easy matter. The tax-payer and the proprietor who have a construction built pay dearly for this fine doctrine, and the building industries, deprived of scientific direction, are misled in trying to realize the fancies of these gentlemen."

CHAPTER XXVII.

APPROACHING COMPLETION.

THE nearer the works approached completion, the more complicated became the office labors. When Paul had seen that nearly all the details had been given to the contractors, he had thought that it only remained for him to supervise the making and putting in place of each part, according to his cousin's instructions; but the office work, which had at first taken two or three hours a day, became still more onerous. The calculations were to be put in order so as to make up the accounts; it was necessary, in order not to lose any time, to give the orders to the workmen, so that they should be on hand at the opportune moment when they were needed, and might work, in certain cases, in concert. The joiner had sent, at the end of August, a part of the doors and casements and nearly all the floorings. It was then time to call upon the locksmith for squares, hinges, and cramps; to get the iron-ware from Tours; hinge-plates, bolts, locks, sliding-bolts, pins, hinges, and so on; and to send the measures of each of these pieces, according to the wood and the nature of

the objects. The cousin went to Tours to get samples of the iron-ware. The joiner and locksmith were at work at the same time; and often, not being used to hurry, it was necessary to regulate the work of each, that no time might be lost. The slaters had arrived, and continually required the assistance of the mason or the carpenter. As their time was paid for dearly, it was important to give them no pretext for indolence.

The cousin had taught Paul how to take account, each evening, of the different work to be entered upon the next day, and how to distribute to each his part before quitting the work-yard. This necessity of foreseeing everything seemed a difficult task to Paul; but little by little his mind had become trained to it, and he became skilful in calculating the work with ease.

The cousin warned him that he must not count on the aid of the workmen in this methodical system; and he himself observed that most of them were not ready to work when the time came, because this or that body of men, who should have prepared the way for them, had not been summoned. Thus time passed in one running after the other.

"The workman," said the cousin, "is naturally improvident, as are all who have been used to being ordered, and who have no responsibility. He knows that such and such a piece of work is to be done, and yet he leaves it up to

the moment of its execution, without ascertaining whether he will have the materials appropriate to his task. Thus, when several bodies of laborers are working at the same time in a yard, the architect must establish order and method, and have foresight. Otherwise, much time is lost; the workmen annoy instead of helping each other; and each does his work without regard to opportuneness. You are likely, in this way, to have to begin the work over two or three times."

The chimney-men came; and though everything had been provided for, in the construction, for the passage of the smoke-shafts, the ventilation, and the heating-funnels of the stove, these workmen were continually having recourse to the mason. The cousin, having arranged everything, told his inspector not to permit the chimney-men to pierce holes here and there for the passage of their shafts, without regard to the construction and the reach of the floorings. But the workmen did not find passages, as they scarcely looked for them; and Papa Branchu was obliged to indicate to them the tubes, to open the mouths, enlarge this, and contract that. Then the plumbers placed the water-pipes, and it was necessary to pierce the walls for them, and make holes for the fastenings. The joiners next demanded the mason to seal up the framework. It was necessary to establish order in all this, for Papa Branchu lost his head, and went from one task to another without completing any.

This part of his work made Paul familiar with details of building of which he had little thought a few months before.

By the end of September the joinery was far advanced, the slating quite completed, and there would soon be nothing remaining to be done but the painting. The calculations were in such order as to enable a ready adjustment of accounts.

Meanwhile M. de Gandelau had thoughts of sending his son back to school at the end of the vacation; it was necessary that he should complete his studies; and if this year had not been lost for Paul, he was still too young to enter upon the study of architecture, even should he desire to pursue that profession. The subject was discussed by the family in the evenings toward the last days of September. The cousin remarked, with reason, that Paul had learned all that was possible in this little work-yard; that should he remain longer in the country, he would see the painters put on their coatings, and that that would not be of any special use to him; and that, besides, as Madame Marie would not come home until spring, it would be wise to let the house dry before decorating the interior and putting up the hangings.

The idea of going back to school, after a year spent in active life, almost always in the open air, did not please Paul overmuch; but he felt that it would not be sensible

to do otherwise. M. and Madame de Gandelau had some matters of business at Paris, and were to pass a part of the winter there.

It was decided, then, that the cousin should remain until the work was completed, so that nothing might be in jeopardy during the bad season; and that Paul should leave with his parents early in October. The painting would not be commenced till the coldest weather was past. The cousin undertook to supervise this operation, and to go over the works himself whilst he stayed at Chateauroux, whither important business would call him towards the end of the winter.

Everything being thus settled, Paul, with swelling heart, left his dear house on the 2d of October, and returned to the lyceum. Most of his schoolfellows had, like himself, passed the year away from Paris, and their studies had been suspended; but very few of them had profitably employed their time. When Paul narrated what he had been doing during these twelve months, some of them made fun of him, some refused to believe him, and all gave him the nickname of "Monsieur the architect."

He had learned, to some extent, during the year, to reason, to reflect before speaking, and to listen to those who knew more than himself; and he thought his old mates rather flippant. He said this one day to his father, with a tone of vanity mingled with sorrow. M. de Gandelau understood

him, and did not let the occasion of correcting the bad side of his thought escape.

"It is possible," said he, "that your mates have not been so fortunate in finding, as you have done, some one willing to take the pains to make them work and ripen their minds; but it would be an unpardonable fault, and above all harmful to yourself, to appear to disdain those who, on a single subject, know less than yourself. Who knows whether they have not acquired a superiority in other things, which you have failed to perceive? You must not, in this world (and the lyceum is a little world much like the great one), shut yourself up in your own knowledge, and derive vanity from it, but try and discover that of others, and avail yourself of it. It is not the true object to shine because you know or think you know something, and thus only attract to yourself the envy of fools, and the smiles of the people of sense, but to make the knowledge of others shine. Thus you derive a double benefit, — to make yourself beloved, and to become instructed. It is not at all surprising that your mates do not know as much as you do about the building of a house; but you must admit that this knowledge is trifling, and perhaps they have more correct and advanced ideas on other subjects than you yourself. It would be ridiculous to conceal from your mates what your occupations have been during your stay in the country, but why insist upon it? If one of them, more anxious to be instructed,

asks you questions, if you see that he takes a real interest in what you tell him, satisfy his wish; but be always reserved with those who are indifferent, or you will be laughed at. There is a true though vulgar saying, that people who are vain of what they know are made to 'pose,' that is, are led to talk, not to satisfy a proper curiosity, but to get a chance to make fun of them. Remember this, for it is as true at the lyceum as elsewhere. If your mind has developed more than those of your comrades, it is easy to make it apparent to every one, by acquiring more rapidly than they the lessons you all study together. Obtain the first place in all your classes; then nobody will laugh at you, and every one will recognize that this year, which has been a useless one to many of the others, has been fruitful for you."

Paul understood, and on returning to school laid aside for the while his architectural memories. He soon showed that his mind had developed, and at the beginning of the new year he brought his father excellent reports of his scholarship.

His mates, however, continued to give him the nickname of "the architect."

"Well," said he to himself, when they called him so, "I will prove to them that they are not mistaken; for I will become an architect."

CHAPTER XXVIII.

THE HOUSE-WARMING.

EVERYTHING went on as had been agreed upon; the painting of the house, begun in the good weather of early February, was completed in April, as well as all the accessory jobs. M. de Gandelau, who had returned to the country towards the end of January, had had the little park laid out around the house, and had ordered the furniture most requisite for occupation, leaving it for his daughter herself to choose the articles consonant with her taste.

Madame Marie had first announced that she should return in April, and then in May. There had been nothing said, since the war, about the house in the letters between herself and her mother. Madame Marie had not, probably, taken in earnest what had been written to her on this subject; and the disastrous events of 1870 and 1871 seemed to have entirely excluded the project from the minds of all.

Paul was anxious to give his sister a complete surprise, and had begged Madame de Gandelau to say nothing about the house to Marie; to which his mother readily consented.

Madame Marie was written to that the family would not assemble at the château until the festival of Pentecost, and that, her father having several journeys to take, she need not hurry to reach France before that time. Madame de Gandelau received, on the 8th of May, a letter from Vienna, saying that Madame Marie and her husband would reach the château on the evening of the 19th, the day of Pentecost.

Great was Paul's joy when he received this news. He would then be at home, and enjoy his sister's astonishment; for he had feared that she might arrive while he was still at school. This would have been dreadful. How ardently he worked during the time which still remained before the Pentecost! He wished to return home with a high place in his class, so that everybody might be happy.

The day of departure, so impatiently looked for, arrived. M. de Gandelau, on account of the distance, and the good reports of his son, had obtained permission for him to come home on Saturday morning. Paul reached the château at noon, after seven months of absence. The cousin had of course been invited to the family festival. Paul scarcely took time to embrace his parents and little sister, and to breakfast; he burned to go and see the house.

"Rest easy," said his mother, "it will wait for you."

During breakfast his father asked him about his studies; but Paul, in his turn, overwhelmed his cousin with questions.

"Is the joinery well done? And the painting? What color is the drawing-room? And the plumber, — has he put the crest he promised on the roof?"

"You will see it all presently, and between now and night there is plenty of time for you to examine everything in detail. A little patience! An architect should, above all, be patient."

The aspect of the house had changed a great deal since Paul's departure. The approaches, rid of rubbish, were carefully sanded. The lawns were growing green; and some old trees having been preserved in the vicinity, it seemed as if the house were already inhabited. Paul could not refrain from leaping for joy to see how pretty and picturesque the building was. On reaching the valley he took to running to see it nearer, and the cousin only reached the steps some minutes after him. Paul had seen neither the entrance marquee nor the greenhouse at the side of the billiard-room. The plumbing had not been wholly completed when he went away, for the spires and crests were not done. The dormer-windows were not crowned by their flower-work. The casements were scarcely adjusted, nor was the glazing inserted. These last jobs are like the border around a drawing, or the frame which envelops a picture. To untrained eyes, this last accessory finishes off each part, adorns the whole, and gives unity which before seemed wanting.

Paul was quite satisfied with the exterior aspect.

The interior, though simple, in accordance with the express injunctions of M. de Gandelau, had a pleasant appearance; there were no signs of stucco ornaments or gilding. A low oaken panelling extended around the hall, joining the door-frames. The wood of the panelling and door-frames had preserved its natural color, and had been simply washed with flaxseed-oil and encaustic. Above the panelling the walls, painted stone-color raised by strips of red, gave a neat and cheerful aspect to the hall, which invited one farther on. The drawing-room was surrounded by a panelling painted white, 1 m. 50 c. in height; the fireplace, wide and high, was sufficient to warm a numerous party. Its frame was of wood; and on its raised mantel, in an oaken frame, a pretty bird's-eye view of M. de Gandelau's domain had been painted. The ceiling, with its beams and joists covered with clear tints raised with white and black strips, made the room look higher, gave it a warm, habitable aspect, and displayed the lights and shadows of an amber color under its openings. Between the ceiling and the white panelling was a hanging of painted cloth. The chimney-piece appeared in bold relief on these foundations. The entrance to the drawing-room would have been somewhat gloomy, had not the large opening into the billiard-room been lighted by a spacious aperture screened by the plants with which the little greenhouse was furnished. But what made the drawing-room especially attractive to Paul was the bay-window, all glittering with light, and around

which was placed a divan of chintz. The billiard-room was also surrounded by an oaken panelling and hangings of painted cloth. A curtain shutting off the bay-window enabled one to retire into it as into a small boudoir, whence the view in three directions was charming. The plants in the green-house caused a soft quiet light to penetrate the billiard-room in the middle. The dining-room had been decorated much like the billiard-room, and two large oaken sideboards were placed between the panelling, in the two alcoves built to receive them.

Paul hurried up to his sister's chamber, all hung in chintz, with a simple brown stylobate, and presenting great simplicity. The ceiling, decorated as were those below stairs, gave it, however, an original and gay appearance.

Paul was anxious to see everything, and his cousin allowed him to wander at will over the house for an hour, as he himself was in conference with some workmen about various details. The sun was low in the heavens when they returned to the château.

"Well, little cousin, are you satisfied with your work; have things been done, in your absence, to please you?"

"I wish very much that it *was* my work," replied Paul, "and I am sorry not to have been able to follow it to the end; for it seems to me, in seeing the completed house, that almost everything was done while I was gone."

"It is with buildings as with all human works. You know the saying, 'Finis coronat opus.' The finishing is the whole.

It does not require the most labor and knowledge, but it demands the most persistence, method, and care, as I have already told you. You have been really useful to me during the construction; that I can say without flattery, because you have exerted yourself to understand and execute my instructions with zeal and all your intelligence. But you could have occupied yourself but little during the completion of the work, as most of the things adjusted at the last have been made in the shops and have been sent ready finished. You have nothing to regret; you would have lost your time here, while, it appears, you have used it to good purpose at the lyceum."

"I have never seen any of these painted hangings; they have a fine effect; one would suppose them to be tapestry."

"Yes; I don't know why these kinds of hangings, which were formerly much used, have been abandoned; for, of course, everybody could not have Flemish or Gobelin tapestries, or Cordova leather. This kind of hangings is very expensive, while the painted hangings do not cost much more than paper, and cost less than furniture stuffs, chintz excepted. But it would not do to hang a drawing-room or dining-room with chintz; it is not substantial to the eye; it is proper for a bedchamber. In large rooms you must have hangings which have a velvety, warm, solid aspect."

"And are these painted hangings solid?"

"Yes, both in appearance and in reality; this is proved by

the hangings to be seen at Rheims, which date from the fifteenth century, and are perfectly preserved."

"How are these hangings made?"

"Of canvas or glazed cloth, with coarse fibres, made for the purpose; like the cloth with which sacks are made. These cloths are stretched on a board with tacks; they are then dressed, that is, a layer of paste, with a little Spanish white, is spread over them. When this is dry the 'distempering' is proceeded with, as in the decoration of a theatre. Anything can be thus painted, — flowers, ornaments, landscapes, even faces. The price of the material is trifling, and whatever value these hangings have depends upon the artist's skill. When they are dry, the cloths are rolled up and sent anywhere at little cost; then they are again stretched on very thin frames, called 'tapestry-frames.' The hangings are thus isolated from the wall, which is necessary in the country, where wall-paper always gets spoiled; so, if the rooms are not warmed in winter, and moisture is feared, the hangings are unstretched, rolled up and put away in a dry place, to be replaced in the spring. The same is done with tapestry."

"I thought, when I opened the drawing-room door, that you had had tapestry hung there."

"The coarseness of the fibre reproduces the semblance of tapestry, and the distempering assumes the dull tone of the worsted. Taken as a whole, the hangings of our house cost scarcely more than the high-priced paper which is manu-

factured nowadays, and they last much longer; without counting that you are sure of not seeing this kind of hangings in every other house."

"That 's true. I have often, in going into a drawing-room, recognized a paper which I have seen elsewhere. But, cousin, I perceive that you have also had lightning-rods put up."

"Certainly; that is the prudent thing to do. I have had two put up, — one on the staircase roof, and the other in the middle of the main ridge."

"One only would not have been enough?"

"I think not; for lightning-rods only protect the points included in a cone of which they are the summit; at least, that is what is said. For, between ourselves, men of science are not agreed on the effects of the electric fluid, the efficacy of lightning-rods, and the precautions to take when they are put up. I adhere to my own experience, which has proved to me that a building, no matter how much exposed, is never struck when it has many lightning-rods, when the conductors are sufficient, are put in communication with each other, and when their lower ends sink into the water or very moist earth. You know that water is a conductor of electricity; if the end of the lightning-rod sinks into dry earth, the electricity accumulates and produces very dangerous sparks in return. The same effect is produced if there are any interruptions in the conducting wire; the lightning-rod then produces the effect of a Leyden jar, becomes charged, and thus

more dangerous than useful. Glass isolators have been recommended; but I have never seen that lightning-rods, otherwise well put up, cause accidents for want of isolators. I think this a superfluous precaution, as the fluid selects the most direct path. The wire, established under good conditions, is this path; and it is necessary to avoid making sudden, angular turnings, and, as far as possible, to carry the wire by the shortest way, and that which is most nearly vertical, to the moist soil."

Nothing was talked of at the dinner-table but the new house and Madame Marie's speedy arrival. There was much discussion as to how to make the surprise a complete one. Then the order of exercises was arranged. M. de Gandelau had given thought to it. The contractors and shop-masters who had worked upon the house were invited, and a dinner was to be provided for them in the garden. Paul's tutor, the mayor and curate of the village, some neighbors and friends, among them M. Durosay, who had reappeared in the vicinity, were requested to lend their presence to the house-warming. The workmen were not forgotten, and all received a present of money; there was to be a ball in the evening, in the new park, for the country people, with ample refreshments; and the poor of the parish were to receive a distribution of food and clothing throughout the day.

Paul was much afraid that his sister might suspect the surprise which was being prepared for her; that, if nothing

was said of the house which had been referred to in the letters to her before the war, this silence would seem suspicious to her.

"He is right," said Madame de Gandelau. "If Marie asks us what has become of this project, and the programme which she sent, if she asks about our occupations during the past year, we shall have to add lies to lies; we shall get into difficulties, and it is a little distasteful not to speak out sincerely to her. We cannot be telling lies for two or three hours; besides, Lucie will betray us."

"O no," said Lucie, "I will not say a word, you may be sure!"

"Your eyes will speak for you, my child. I will manage that. You will leave me alone a little while with Marie. I will tell her that Paul, to busy himself during his vacation, has built a little house, with his cousin's advice. I will let her suppose that it is but a school-boy fancy. She will think it only a pastime, and will imagine a little model of a building well made. We can then speak at ease, in a tone of pleasantry. Then, after breakfast, we will propose to her to go and see Paul's house."

This was the plan agreed upon.

Paul slept little that night, though he had set out from Paris very early, and had made good use of his legs all day.

On the 19th of May, 1872, at 9.40 A. M., M. and Madame

N—— descended at the station at X——, where M. de Gandelau was awaiting them with a handsome carriage. Twenty minutes afterwards they entered the court-yard of the château. It is useless to describe the embracings, the joy mingled with tears, lavished during the first moments of this return.

Madame de Gandelau had had the rooms of the couple arranged with all possible care, as if they were to make a long stay at the château.

The mother did not fail to find her daughter improved; Madame Marie found Paul grown almost to manhood, and Mademoiselle Lucie almost a young lady.

Thanks to Madame de Gandelau, Paul's house was only talked of, at breakfast, as an unimportant incident. The travels of Marie, and the war, were the subjects of conversation. There was plenty to speak of, after an absence of twenty-two months. But Paul was agitated and absent, and his sister noticed it. Paul blushed to his eyes.

"Paul seems to be thinking of something," said M. N——.

M. and Madame de Gandelau glanced at each other and smiled.

"What is it all?" asked Marie. "A conspiracy?"

"Perhaps," replied her mother, "but let us have the pleasure of bringing it to a good end."

"Go on conspiring, mamma; I will assist you with all my heart."

It would not do to speak of taking the excursion then, for the secret would be betrayed. Madame de Gandelau proposed that her daughter should take some rest after her journey. M. N—— asked permission to send off some urgent letters, and the château became silent again.

The day was warm, and nothing was heard but the buzzing of the insects on the lawn. Paul, however, could not keep still.

"You are no diplomat yet," said his cousin. "The deuce! keep quiet, will you? You are the only person astir in the house. You will betray yourself if you keep on. Go to your room, take a dull book, and you will go to sleep, and so pass the time away."

"But the invited people are all waiting below, yonder."

"O yes, that's true! Well, mount your horse, ride to the house, and ask the guests to gaze at the marvels of the new establishment, and to have patience. Say that your sister is a little tired, and will not make her appearance till this afternoon. Then come back."

Paul did not wait to have this repeated, for it seemed impossible to him to keep quiet. He would have given ten years of his life if his sister would only get into the carriage.

It is hard to say what the pony thought when Paul brought him out this hot day. He foamed at the mouth when he reached the house, and many of the guests hur-

ried up to know if there was any bad news. When Paul, with the most frightened air in the world, told them that Madame Marie would not appear for some hours, as she was resting herself, they all said, —

"If that is all, there is no hurry; it's very natural after so long a journey."

Then each asked news of Marie and her husband; and Paul was asked to look at this and that. Paul was boiling over.

"You are not going to mount your horse in your present state," said the mayor; "you are all perspiration, and your pony is white with foam; rest a little, and drink a glass of wine."

He had to surrender, for the mayor had brought a small hamper of Saumur wine. They drank to the health of the newly arrived couple, and to the prosperity of the house, and so Paul lost an hour there. At last he returned towards the château. On reaching the crest of the hill he saw the carriage in the distance, coming towards the house. He turned aside so as to cross to the party, and reached them just as the new house came into view.

"See," said his sister, "here is a cavalier quite out of breath. Where has he come from? Is it he who has the lead of the conspiracy?"

"Certainly," said her mother. "Look!"

They could now see the outline of Paul's house, its slated

roof glittering beneath the sun's rays. There was a silence, and some emotion.

"I had a suspicion," said Marie, embracing her mother and father. "So you were thinking enough of us, amid the anguish of the past year, to realize this project of a house, which I thought to be only a castle in the air? And Paul!"

"Paul has been at work," said M. de Gandelau, "and has had his good part in the success of the project. If he ever becomes a famous architect, you will have been the first cause of it."

"And you, my friend," said Madame de Gandelau to her son-in-law, who tenderly kissed her hand, "you say nothing!"

"M. de Gandelau wrote to me, and I was in the secret. Marie will tell you how well I have kept it!"

"So we were betrayed, my dear Paul!" cried his mother.

"M. de Gandelau wished to know if a residence here would not disturb our plans for the future. I replied to him that, on the contrary, it would further them, and that the only reason why I did not undertake to build a house here after our marriage was the fear of wounding you, and making you imagine that we did not attach to your maternal hospitality the value you know how to give it. Marie wishes to reside here a large part of the year; she is known and loved in this vicinity, where she was born. Nothing could be more pleasant to her than to follow your example, near you, almost under your eyes, without causing you the embarrassment of a perma-

Fig. 62. — THE HOUSE-OPENING. — Page 282.

nent sojourn in your own house. I had no need of consulting her, for I knew that you would realize the dream she caressed, without having the hope of its near realization."

"All is then for the best," resumed Madame de Gandelau, glancing at her husband; for she recalled what he had said to her one evening, two years before.

The family were welcomed at the steps of the new house by the merry-makers. Before going in, they walked around it; and finding themselves before a group of contractors and master artisans, Paul presented them to his sister, saying that it was owing to their zeal and the desire to see her soon settled down here, that the building had been completed within two years. Paul's well-turned compliment and his sister's graceful bearing, who asked after the families of each, and expressed a wish to employ them often, gained the hearts of these honest people, most of whom had known her from childhood up.

Marie wished to see everything. There were explosions of joy at each step, and Paul was many times embarrassed by his "client." M. N—— had possessed himself of the cousin, who, it is needless to say, was warmly congratulated.

M. Durosay was constantly expressing his admiration, and repeating, "It is a charming seignorial manor!"

"But," said Marie, at last, turning suddenly, "why do you call this a manor and seignorial? I have no vassals, nor do

I wish for any. Say, then, that this is a house built for me by those who love me, which shall always be open to my friends, and always accessible to those who have need of us."

They say that Paul is more than ever determined to embrace an architect's career.

THE END.

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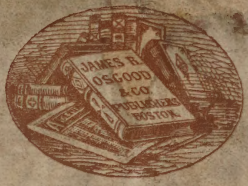

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